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PESTICIDE POISONING OF POND LICK LAKE, OHIO INVESTIGATION AND RESOLUTION, JUNE 2-JULY 5, 1971

Rychman, Edgerley, Tomlinson and Associates, Incorporated

Prepared for:

Environmental Protection Agency

1971

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Investigation and Resolution

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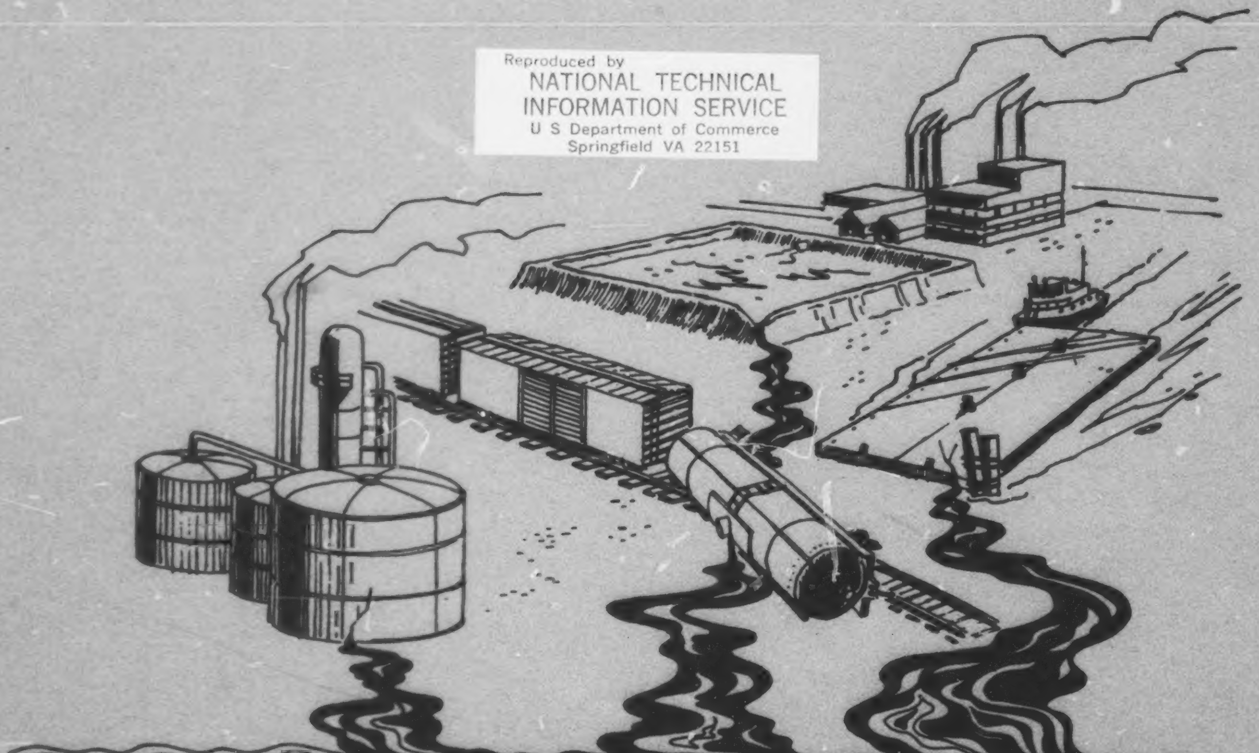

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Pesticide Poisoning of Pond Lick Lake, Ohio
Investigation and Resolution
June 2 - July 5, 1971

FINAL REPORT

Prepared by

Ryckman, Edgerley, Tomlinson and Associates, Inc.
St. Louis, Missouri

under Contract No. 68-01-0045

for

Environmental Protection Agency
Division of Oil and Hazardous Materials
Office of Water Programs
Washington, D. C.

FOREWORD

This report is one of a program series on the prevention of and responses to discharges of oil and hazardous materials into the navigable waters of the U.S. These actions are carried out under the provisions of Section 11 and 12 of the Water Quality Improvement Act of 1970 (PL 91-224). Other reports have discussed topics on the state of the art, prevention techniques and types of materials that may be considered hazardous polluting substances.

The United States Environmental Protection Agency (EPA) recognized that an immediate response is essential in dealing effectively with environmental incidents. Therefore, in 1970 a program was organized through the Division of Oil and Hazardous Materials of the Water Programs Office of EPA which would facilitate a rapid response to hazardous spill emergencies throughout the U.S. The program calls for close coordination between state, federal and private organizations. In order to minimize the response time, and to supplement EPA resources, several private contractors have been chosen in various parts of the country to work with EPA on spills of oil and other hazardous polluting substances. Ryckman, Edgerley, Tomlinson and Associates, Inc. (RETA) is one of those contractors chosen to provide on site technical assistance to EPA during such emergencies.

This report prepared by the contractor describes the efforts of the United States Environmental Protection Agency in rendering assistance to the State of Ohio in order to combat a potentially dangerous spill of a pesticide mixture in the Pond Lick Reservoir near Portsmouth in southern Ohio. The investigation and resolution of this emergency, as described in the following report, were directed by the Division of Oil and Hazardous Materials as On Scene Spill Coordinator, with the emergency technical assistance provided by the contractor and the extensive support and able field activities of the State of Ohio Department of Natural Resources.

Dr. C. Hugh Thompson
The Division of Oil and Hazardous Materials
Office of Water Programs
Environmental Protection Agency
Washington, D. C.

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PESTICIDE POISONING OF POND LICK LAKE, OHIO
INVESTIGATION AND RESOLUTION
June 2 - July 5, 1971

SPILL DEFINITION

Pond Lick Reservoir[1] is located in the Shawnee State Forest approximately ten miles southwest of Portsmouth, Ohio and 125 miles east of Cincinnati on the Ohio River. (See Figure 1.) At one time it served as a reservoir for an honor camp of the Ohio penal system until that facility was closed down several years ago. With boating and fishing permitted, the reservoir presently serves as a popular recreational site within Shawnee State Park. The lake is about 1,000 feet long and 250 feet wide at its widest point, with regular shores and no swamps. A watershed of about 4.5 square miles drains into the lake, which is about 35 feet deep at its deepest point, with an average depth of about 15 feet.

On June 2, 1971 approximately one gallon of a mixture of a concentrated pesticide solution and strychnine-treated corn, which is often used for rodent control, was deliberately dumped into the lake.[2] Although the pesticide poison was contained in a plastic gallon container which apparently floated on the lake for a period of time, it eventually contaminated the lake and within days killed the lake wildlife, including an estimated 3,400 sunfish, carp, blue gills, and other fish together with numerous frogs, snakes, and other aquatic life. The plastic gallon container was eventually recovered from the lake by the State of Ohio. The pesticide was determined to be an 18.6% Endrin wettable emulsion with a petroleum hydrocarbon content of 73% and an inert content of 8.4%. The wettable Endrin emulsion rapidly goes into suspension in water; by the time the spill was discovered, the Endrin had mixed with all the surface waters of the lake. The measured Endrin concentration[3] of greater than 9 parts per billion (ppb) in the lake water is consistent with the estimated lake volume (approximately 15 million gallons) and the assumed magnitude of the spill. In the absence of normal

---

[1] Also referred to as Pond Lick Lake and Shawnee Lake.

[2] Later a suspect was arrested and held in $3000 bail on charges of destroying state property and wildlife.

[3] As discussed below, the concentration varied with depth and was significantly less below the thermocline.

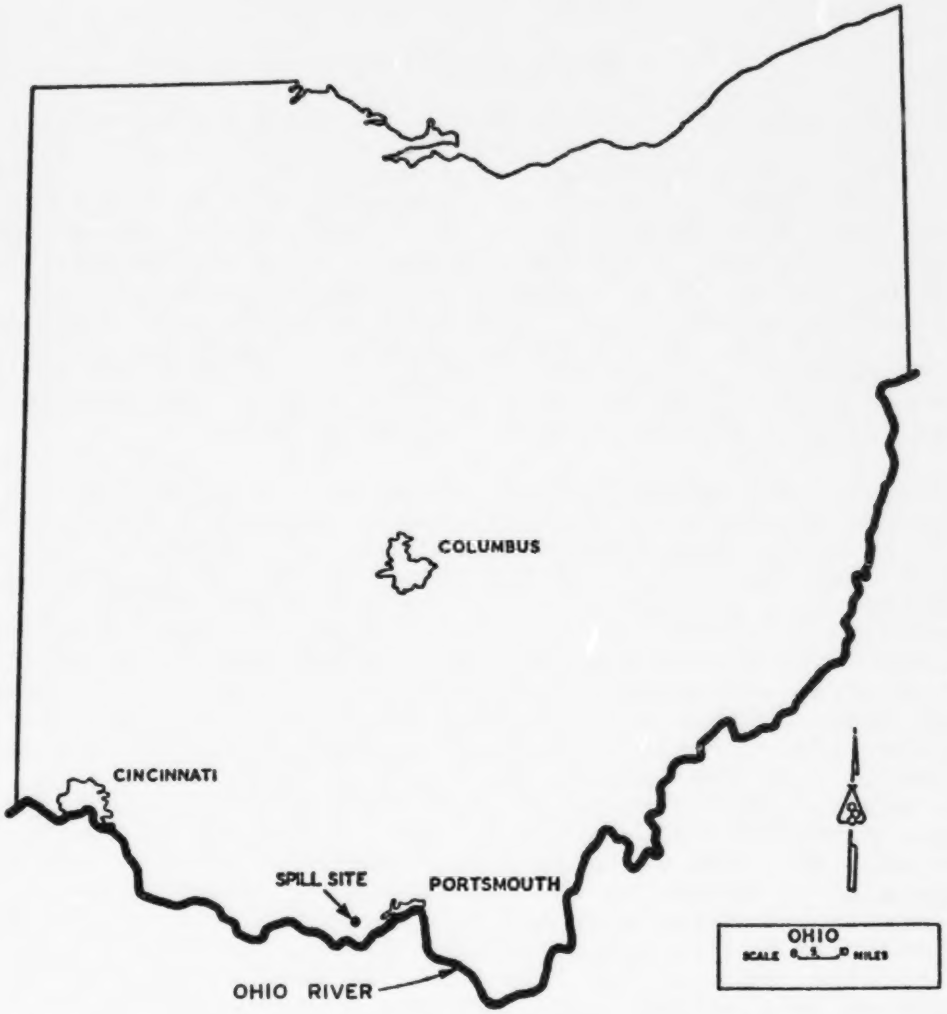
COLUMBUS
CINCINNATI
SPILL SITE
PORTSMOUTH
OHIO RIVER
OHIO
SCALE 0 5 10 MILES

Figure 1 - Spill site location and its proximity to Ohio River.

rains, the relatively low flow rate of Pond Lick Creek, which was approximately 20 gallons per minute in the days following the spill, ensured that by the time EPA was contacted and emergency cleanup operations began several days later, the poison was still largely confined to the lake. Nevertheless by June 10, eight days following the spill, all the fish up to a distance of two-tenths of a mile downstream from the lake were killed and noticeable toxic effects in fish and other aquatic life up to a distance of six-tenths of a mile downstream were noted. Beyond that distance the aquatic life was apparently normal.

The strychnine (0.05 - 1.0%) that was spilled with the Endrin was in an insoluble form on dried corn. It was not a matter of great concern in the incident because it was not present in large concentrations and strychnine readily breaks down when exposed to sunlight. Endrin, however, is one of the most toxic and persistent of the chlorinated hydrocarbons, and was present in concentrations considered to be toxic to humans, and deadly to fish and other aquatic life[1] and wildlife, as shown in Table 1.

TABLE 1

TOXICITY OF ENDRIN

Species	TLm (ug/l) (1)
P. Californica	0.8
P. Pulex	20.0
Blue gill	0.2
Gammarus Lacustris	4.7
	Oral LD (2)
Dog	10 mg/kg
Monkey	3 mg/kg
Rabbit	7 mg/kg
Quail	14 mg/kg

(1) Report of the Committee on Water Quality Criteria, FWPCA, 1968.

(2) McKee and Wolf, Water Quality Criteria, 2nd ed. Sacramento, California.

---

[1] For example TL_{100} for blue gills is 0.6 ppb (96 hours).

The extreme toxicity of Endrin is compounded in seriousness by two important facts: (1) it does not degrade rapidly and, in fact, may persist in an aquatic environment for as long as ten years; and (2) it is subject to "biological magnification" in the aquatic food chain. That is, even if it were present in vastly diluted concentrations from that found in the lake, which could happen if it were allowed to continue downstream, primary producers and predator organisms can concentrate the poison in their bodies to a high degree by feeding upon other organisms that have picked up lesser amounts of the Endrin poison. In this way aquatic life such as catfish might pick up levels of Endrin in their bodies that exceed Federal Drug Administration standards for human consumption even though the aquatic environment contains only trace amounts of Endrin.

ACTIVATION OF STATE AND FEDERAL RESPONSE TEAMS

Initial Communications

When the spill was discovered, officials of the Ohio Department of Natural Resources were concerned by the proximity of Pond Lick Lake to the Ohio River. As shown in Figure 2, the lake is less than 10 miles from the Ohio River. The spill thus posed a potential threat to the river. Because of the potential magnitude of the problem, on June 10 the Department of Natural Resources asked the Chicago office of EPA for assistance. Because the threat to the Ohio River was sufficiently great to require EPA assistance in the incident, Mr. Angell Sidio of the National Field Investigative team of the Cincinnati office of EPA reported to the site on June 10. Dr. C. Hugh Thompson, Division of Oil and Hazardous Materials of EPA/Washington was informed of the spill on June 12. Due to the imminent and substantial threat to the Ohio River, the Emergency Response Contractor, Ryckman, Edgerley, Tomlinson and Associates (RETA) was activated to provide immediate on-site technical assistance to determine the adequacy of the measures already implemented by the State and to suggest alternate countermeasures. In addition, the contractor was asked to provide technical advice to Mr. Sidio and other EPA personnel on-site, and to undertake limited downstream observations and photographs necessary to prepare an incident report dealing with the causes, effectiveness of counter measures, timeliness of response, short-term and long-term effects of the spill and steps that may be taken in the future to prevent such a spill incident.

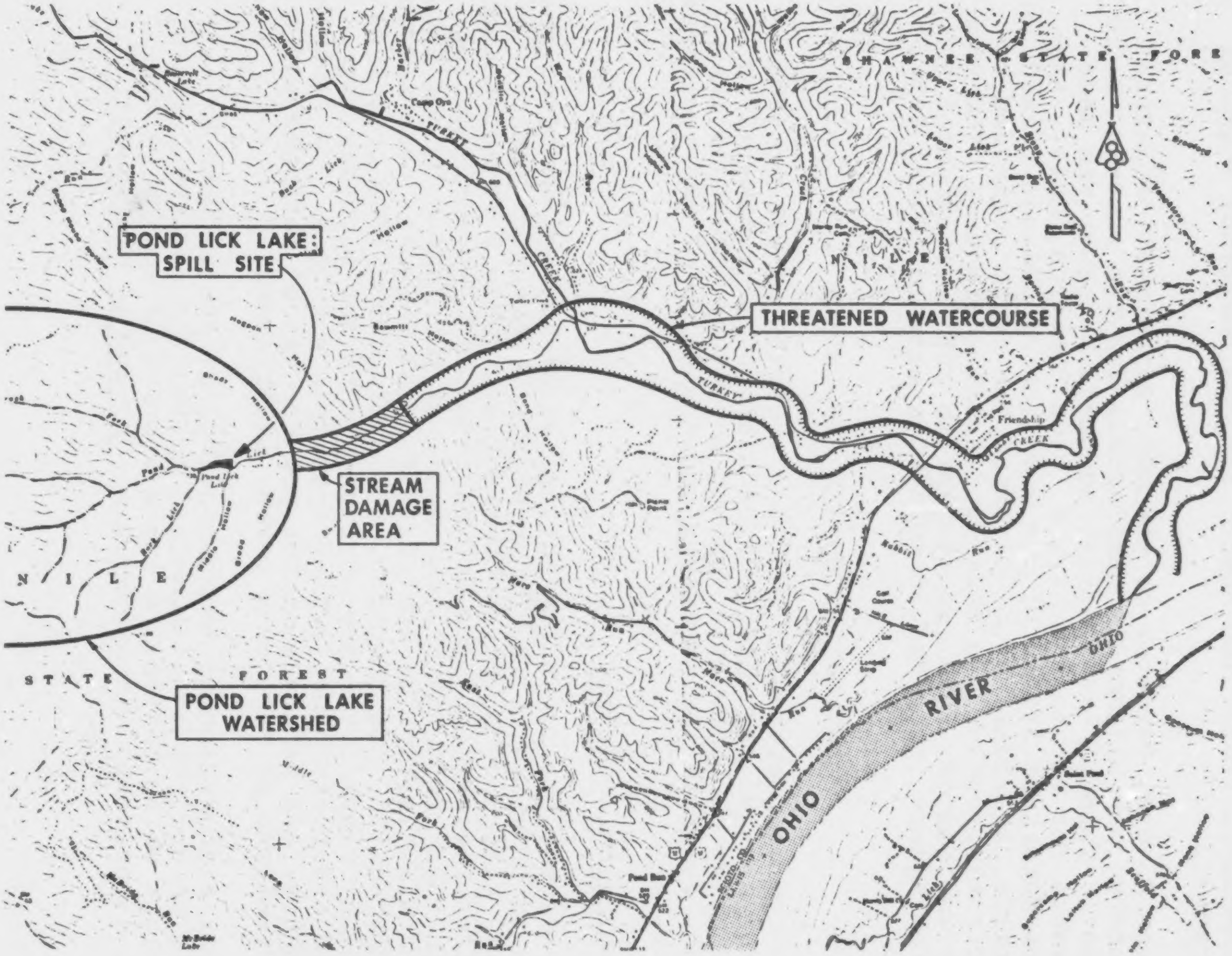
POND LICK LAKE: SPILL SITE
THREATENED WATERCOURSE
STREAM DAMAGE AREA
POND LICK LAKE WATERSHED
SHAWNEE STATE FOREST
NILE
STATE FOREST
TURKEY CREEK
Friendship
OHIO RIVER
OHIO

Figure 2 - Watercourses threatened by poison in Pond Lick Lake.

Organization and Personnel

The organization and management of this project is depicted schematically in Figure 3. The diagram illustrates the working relationship between the State of Ohio, the United States Environmental Protection Agency and the Emergency Response Contractor.

William B. Nye, Director of the Ohio Department of Natural Resources, was ultimately responsible for the success of the project. Through his efforts, adequate manpower was made available for all tasks. Dr. C. Hugh Thompson, Chief, Hazardous Materials Branch of the Division of Oil and Hazardous Materials, EPA/Washington, directed the teams organized to efficiently resolve the hazardous spill emergency. The emergency contractor, RETA, as advisor to the Environmental Protection Agency, provided immediate on-site technical expertise.

INVESTIGATION AND RESOLUTION

This section presents (1) a broad overview of the project through a brief chronological tabulation of events; (2) a description of key events leading to the selection of the design, construction, start-up and operation of the treatment plant.

Chronological Overview

Table 2 outlines the daily activities of key personnel of the State of Ohio, the U. S. Environmental Protection Agency, and the Emergency Response Contractor. Table 2 is an attempt to illustrate some of the interactions that occurred during the incident from the initial spill of the Endrin to notification and activation of the State/Federal response team and subsequent design, construction, and operation of the prototype treatment plant. The sequence of events for each day are listed under the group most responsible for them. By studying the chart, the progress of the project can be followed and the contributions of each team member ascertained.

Further elaboration of the chronological events with emphasis on project initiation and activation and the critical decisions which controlled the direction of action by the team, is presented in Appendix A, Chronology of Project.

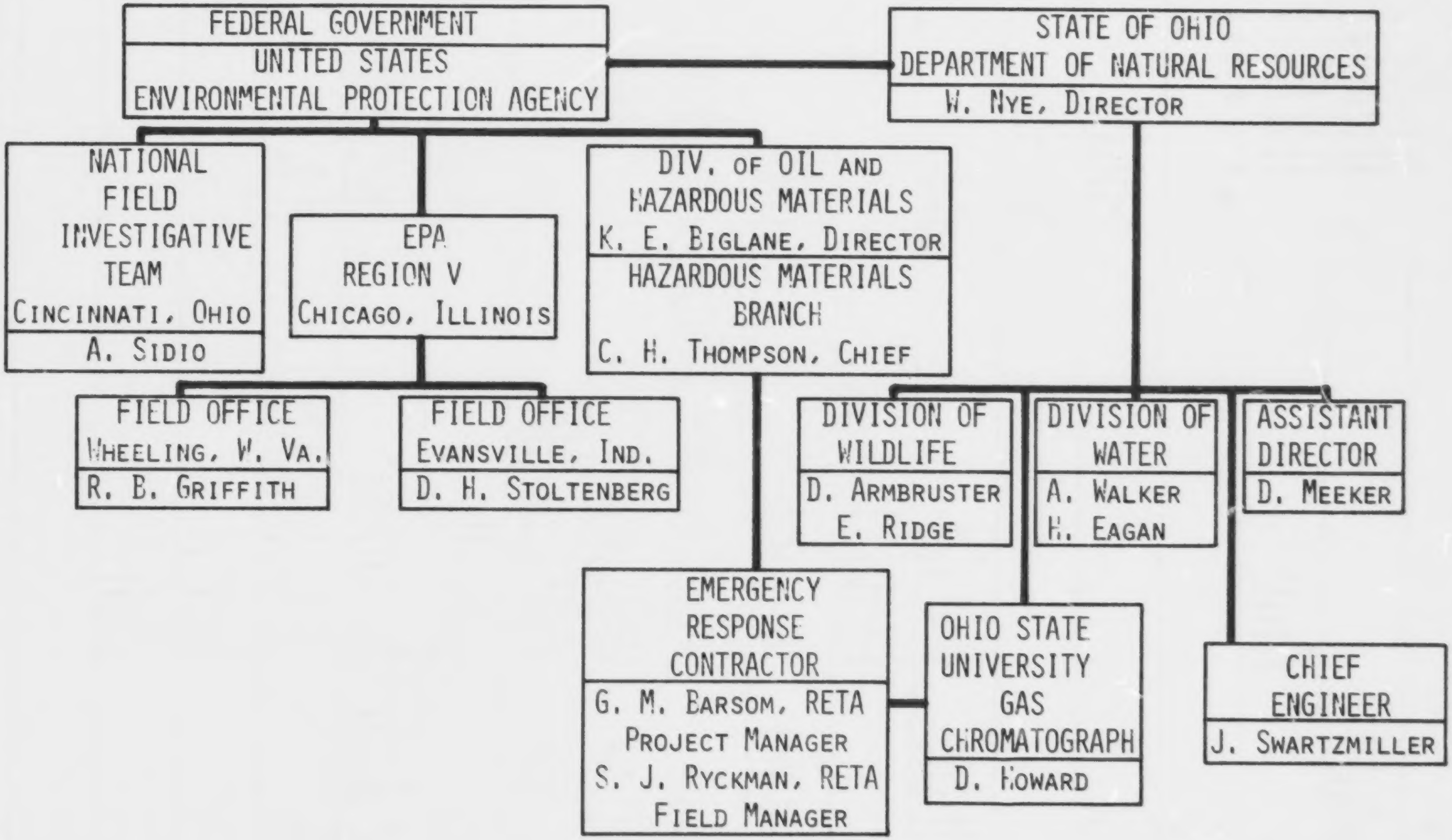
FEDERAL GOVERNMENT
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
W. NYE, DIRECTOR
NATIONAL FIELD INVESTIGATIVE TEAM
CINCINNATI, OHIO
A. SIDIO
EPA
REGION V
CHICAGO, ILLINOIS
DIV. OF OIL AND HAZARDOUS MATERIALS
K. E. BIGLANE, DIRECTOR
HAZARDOUS MATERIALS BRANCH
C. H. THOMPSON, CHIEF
FIELD OFFICE
WHEELING, W. VA.
R. B. GRIFFITH
FIELD OFFICE
EVANSVILLE, IND.
D. H. STOLTENBERG
DIVISION OF WILDLIFE
D. ARMBRUSTER
E. RIDGE
DIVISION OF WATER
A. WALKER
H. EAGAN
ASSISTANT DIRECTOR
D. MEEKER
EMERGENCY RESPONSE CONTRACTOR
G. M. BARSOM, RETA
PROJECT MANAGER
S. J. RYCKMAN, RETA
FIELD MANAGER
OHIO STATE UNIVERSITY
GAS CHROMATOGRAPH
D. HOWARD
CHIEF ENGINEER
J. SWARTZMILLER

FIGURE 3 -- PROJECT ORGANIZATION

SEQUENCE OF EVENTS

	Wed. June 2	Thursday June 10	Friday June 11	Sat. June 12	Sunday June 13	Monday June 14	Tuesday June 15	Wed. June 16	Thursday June 17	Friday June 18	Sat. June 19	Sunday June 20	Monday June 21	Wed. June 23	Thursday June 24	Friday June 25	Sat. June 26	Monday June 28
OHIO	Poison dumped in lake in Ohio	DNR asks EPA for assistance	Spillway dammed	Diversion dam started Activated Carbon on lake	Finish diversion dam Begin by-pass Raise Sandbags Post guard around lake	Raised dam Built by-pass Set up pumps	Formal assistance request sent to EPA W. Nye, meets CHT in travel to site	Power installed at dam W. Nye locates G. C. at O.S.U. Build pilot plant	2:a.m. G. C. arrives at dam with D. Howard Telephone installed at site	G.C. analysis shows good pilot plant operation Build prototype plant	Complete prototype plant	Modify filter Dave Howard briefed on safety Dave Howard briefed on safety	State to pick up as EPA pulls out	Electric submersible pump ordered to stop air bubbles	Electric Pump Operation 2:30 p.m. No air in filter	Heavy rain, lake level rises 18"	Conditions stabilised Construction of emergency spillway filter begins	Filter and spillway filter operate to 400 GPM
EPA		EPA notified National Field Team to scene	Bioassay Fish die 2 hours G. C. sample to Cinn. Dam spillway	C. H. Thompson notified Information gathered National Field Investigative Team input to Hazardous Materials Branch	Bioassay & Chemical analyses Stream damage survey. Suggest stop using wells in area.	Depth samples taken, temperature profile C. H. Thompson receives report	CHT to Columbus meets with DNR travels to site CHT decides pilot plant needed Comprehensive sampling program requested	CHT attempts to locate EPA carbon filter plants. All are in use CHT works to find GC	2 a.m. CHT, D. Howard set up G.C. Results at 10a.m. pilot plant working CHT locates tank for prototype plant Decides to build prototype based on pilot plant success	6 a.m. Repairs Pilot Plant CHT directs construction of prototype	Construction continues Plant in operation 5:30 p.m Air bubbles in filter cause problems shut down prototype plant	Modify filter CHT leaves Dave Stoltenberg in charge				Conference CHT about heavy rain conditions		
RETA				RETA notified Accepts job	RETA to field from Dayton & St.Louis Assess damage Recommend no more carbon	Prepared situation report, delivered to CHT Second report sent	Design Pilot Plant, start construction	Build pilot plant Pilot Plant Operation begun at 10:30p.m.	Operate and sample pilot plant Begin design calculations on prototype plant	Detailed Construction description by SJR		Modify filter Restart	Filter Modifications with state Need for 24 hour operators noted	Operating & emergency proceedure instructions created				

TABLE 2

KEY:

DNR	Ohio Department of Natural Resources
EPA	Federal Environmental Protection Agency
RETA	Ryckman, Edgerley, Tomlinson, & Associates
CHT	Dr. C. H. Thompson
SJR	S. J. Ryckman
G.C.	Gas Chromatograph

Treatment Process Selection

The Ohio Department of Natural Resources undertook the project under the leadership of William B. Nye, whose objective throughout was to handle the project in the best interests of the citizens of Ohio and cleanse the lake as quickly as possible. The Ohio team initiated the critical first step of isolating the reservoir. They accomplished this by sandbagging the spillway, building an earth diversion dam upstream from the lake, and providing two 2,500 GPM pumps and 10 inch aluminum piping to enable Pond Lick Creek to bypass the now isolated reservoir (see Figures 4, 5a and 5b). The dam was completed Sunday night, June 13, 1971, and the pumping system was completed on Monday, June 14. The bypass system was a temporary one designed to protect the lake if rain occurred in the area. Because of its limited capacity in the event of a heavy rain, Ohio officials stressed the need for a quick cleanup action. Bags of activated charcoal were added to the spillway to cleanse the seepage and a pump was added in the downstream stilling basin to pump the seepage back into the reservoir.

The first EPA support to arrive on the scene was the National Field Investigative Team (NFIT) from Cincinnati. Together with the Ohio group they first attempted to reduce the concentration of Endrin in the reservoir by broadcasting approximately 6,800 pounds of 40 mesh granular activated charcoal (see Figure 6). The method had the advantages of being quick, easy and inexpensive, and it achieved a limited reduction in Endrin concentration. However, subsequent investigation showed that for the type of activated carbon available, the contact time, that is, the time before the activated carbon settled to the lake bottom, was insufficient to reduce the Endrin concentration to tolerable levels. Furthermore, unless subsequently removed, the Endrin could adversely effect the benthos or desorb from the carbon into the lake water.

The Emergency Response Contractor made a systematic investigation of the extent of the contamination, the effects, the topographic characteristics pertinent to a solution of the problem, and a study of possible countermeasures. On the spot observations were collected and issued in a series of situation reports on June 14 through June 18, for the use of the men working at the site, for EPA information, and for later use as documentation (see Appendix B).

Upon arrival at the site on Sunday, June 13, the Contractor reviewed and agreed with Ohio's plans for the diversion dam and pumping system and recommended increasing the height of the sandbags on the spillway. The Contractor also suggested

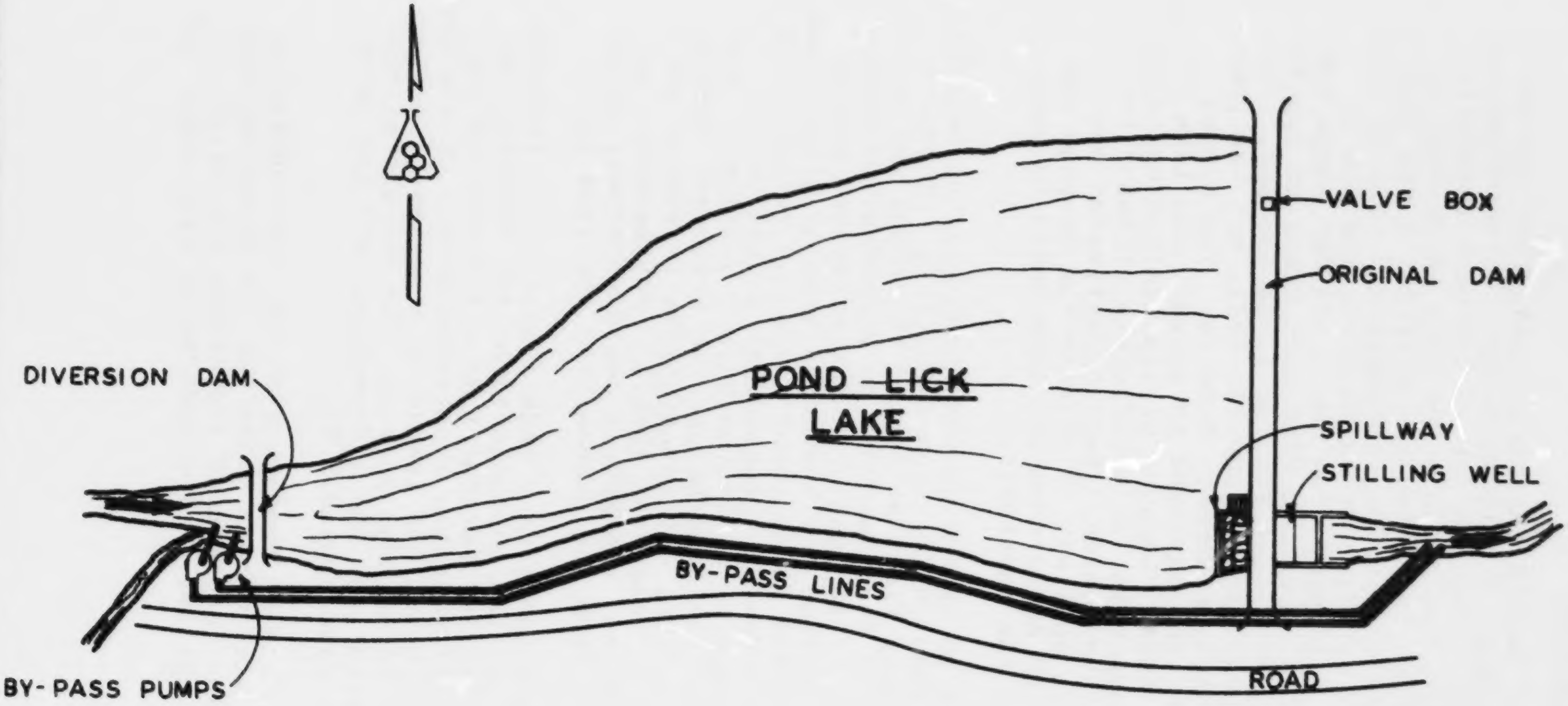
VALVE BOX
ORIGINAL DAM
DIVERSION DAM
POND LICK LAKE
SPILLWAY
STILLING WELL
BY-PASS LINES
BY-PASS PUMPS
ROAD

FIGURE 4

DIVERSION DAM AND BY-PASS SYSTEM INSTALLED AT POND LICK LAKE

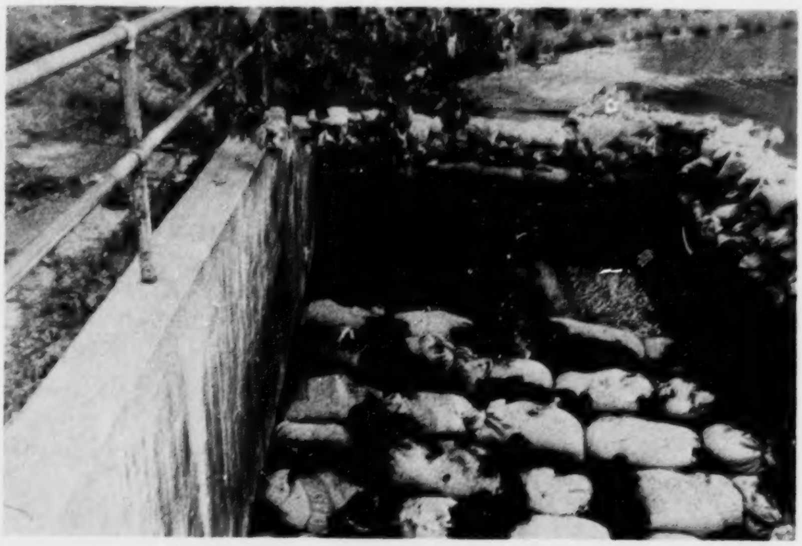

Figure 5a - Spillway structure of Pond Lick Reservoir. Note sandbagging of the spillway and bags of activated carbon to stop lake water from contaminating downstream.

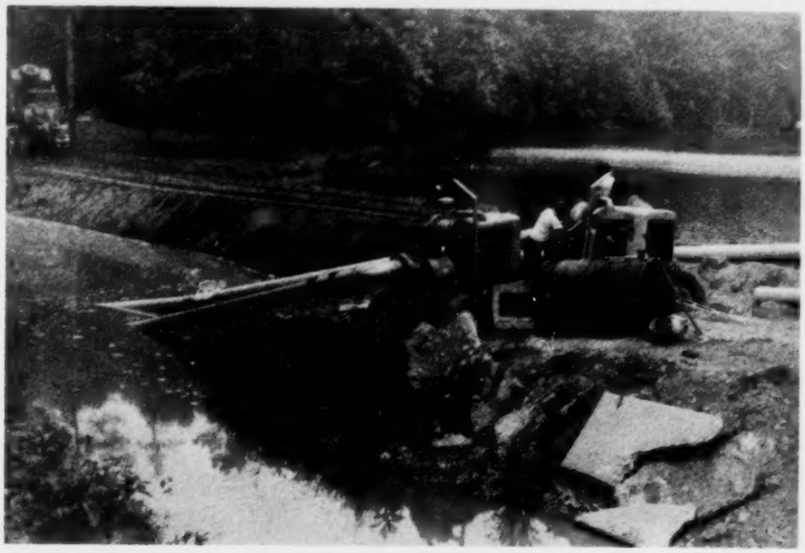

Figure 5b - Temporary dam to cut off flow from influent stream to Pond Lick Lake. Note by-pass pumps upstream from dam which divert water around reservoir.

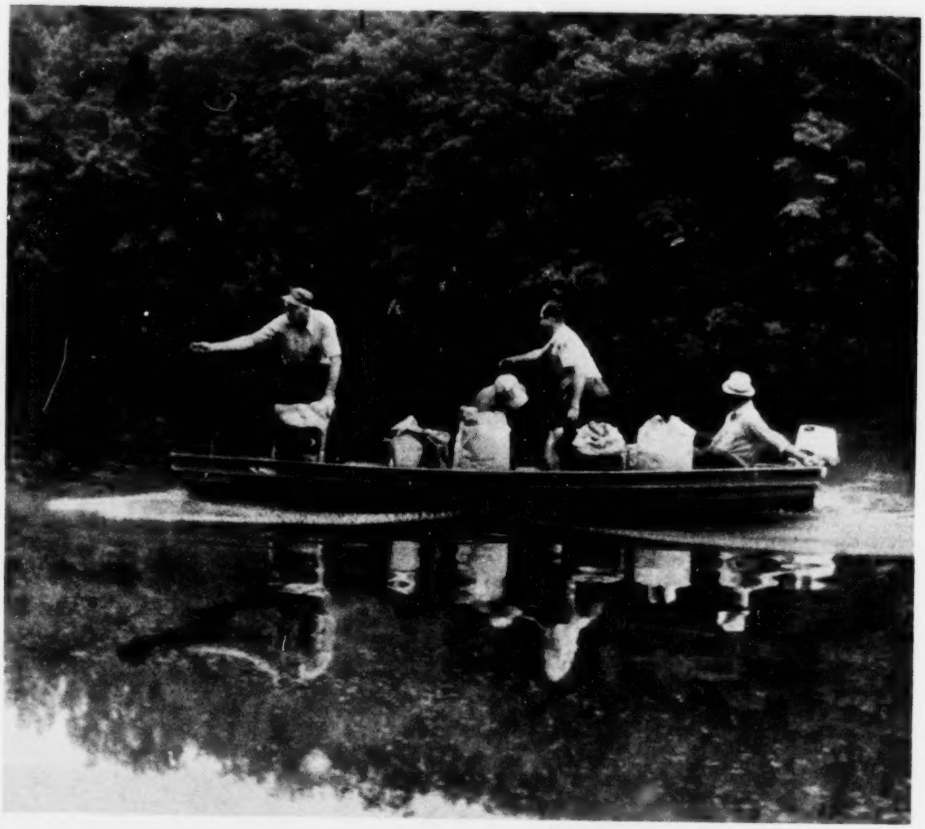

Figure 6 - Broadcasting activated carbon over surface of lake in an early attempt to remove Endrin from the water. (Courtesy Portsmouth Times)

to NFIT that the public be kept away from the area. NFIT advised the state and officials implemented the quarantine later in the day Sunday.

An initial concern was the possible contamination of ground water, and nearby wells in particular. The Department of Natural Resources, Division of Water, provided the Contractor with well logs and basic information which enabled rapid reporting on the geology of the area. This information showed that a 40 foot thick layer of impermeable shale separated the lake from ground water, and that ground water in the area was very poor. Many drilled wells are dry or provide a flow of less than five gallons per minute. It was concluded that it was unlikely that any ground water contamination would occur unless the entire lake were to drain to the Ohio River flood plain at one time. The flood plain contains aquifers which are potentially very good sources of water. These aquifers might be endangered by either a rapid discharge of the water or activity such as landfilling bottom material scraped from the lake. A complete geological description of the region surrounding Pond Lick Reservoir is presented in Appendix C.

Treatment System

Next, and most important, it was essential to devise an effective means of eliminating the Endrin contamination. The countermeasures which were proposed and discussed are presented in Appendix D. However, the method of treating the lake water by running it through an activated carbon contact bed seemed most attractive. Because of the earlier failure of carbon to significantly reduce the Endrin concentration, the EPA On Scene Spill Coordinator (OSSC) made the decision on June 15, 1971, to construct and operate a pilot plant to determine:

a. the ability of carbon to remove Endrin and produce an effluent non-toxic to aquatic life.

b. the absorptive capacity of activated carbon for Endrin.

c. the necessary loading rates for proper carbon contact and Endrin absorption.

d. how to best construct the filter system.

e. whether a pre-filter was needed to remove suspended material.

The Emergency Response Contractor designed the pilot plant based upon rough sketches provided by the EPA On Scene Spill Coordinator (OSSC) and aided the Ohio workers in building the plant on the night of June 15. The plant was in operation by the afternoon of the next day, June 16. The pilot plant installed on the dam is shown undergoing adjustments in Figure 7.

In order to optimize operation of the pilot plant, it was necessary to monitor the Endrin concentration influent and effluent to the process. The only available analytical instrumentation was located in the EPA Cincinnati laboratories. This was inadequate to properly optimize the pilot plant performance because of the several days delay involved in transporting the sample to Cincinnati. In order to alleviate this constraint, the OSSC initiated an intensive nation-wide search to locate a portable gas chromatograph and operator that could be flown to the spill site. The OSSC search, which began on June 13, was successfully concluded on June 16 by the State of Ohio following a lead of the OSSC. The Ohio State University instrument was transported to the site and set up in an old CCC camp kitchen which was quickly converted into a laboratory. With the OSSC's help, the operator[1] calibrated the chromatograph and placed it in operation in the early hours of June 17, 1971 (see Figure 8).

TABLE 3

PILOT PLANT OPERATING DATA

Endrin Concentration (ppb)		Flow	Hours of	Gallons
Influent	Effluent	gpm	Operation	Treated
6.66	0		0	0
6.66	0	3.7	1	220
6.66	0	3.3	2	420
6.66	0	7.5	3	870
6.66	0	7.3	4	1,340
6.66	0	1.1	5	1,410
6.66	0	7.0	10	3,550
6.66	0.050	7.0	11	3,970
6.66	0.050	5.7	40	13,880

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[1] David Howard, Ph.D. candidate, Department of Biology, Ohio State University.

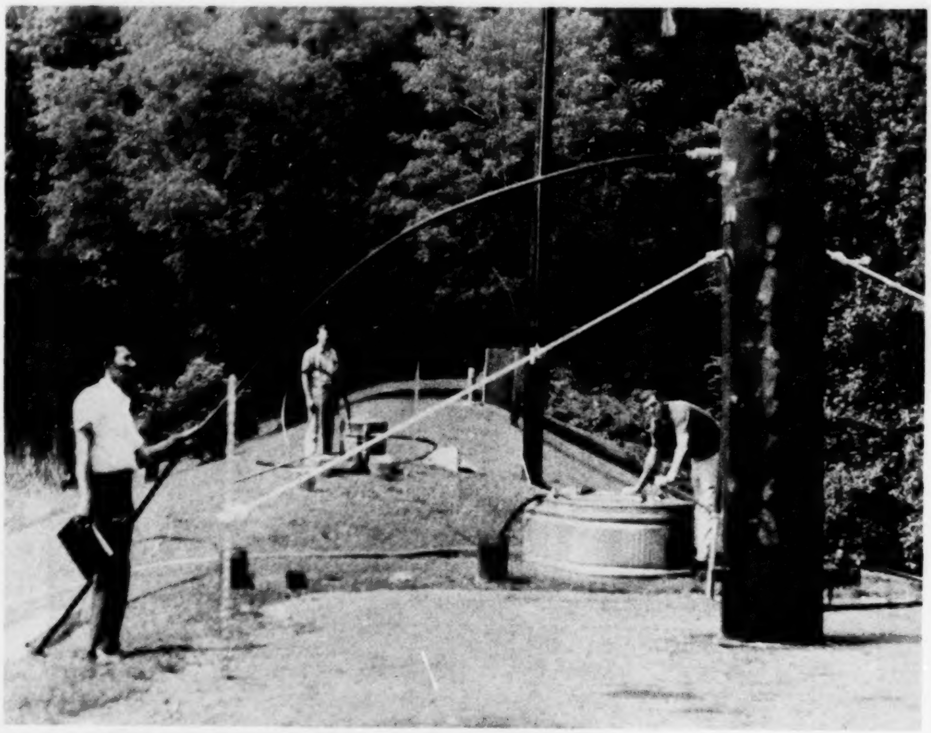

Figure 7 - Pilot plant start-up and operation.

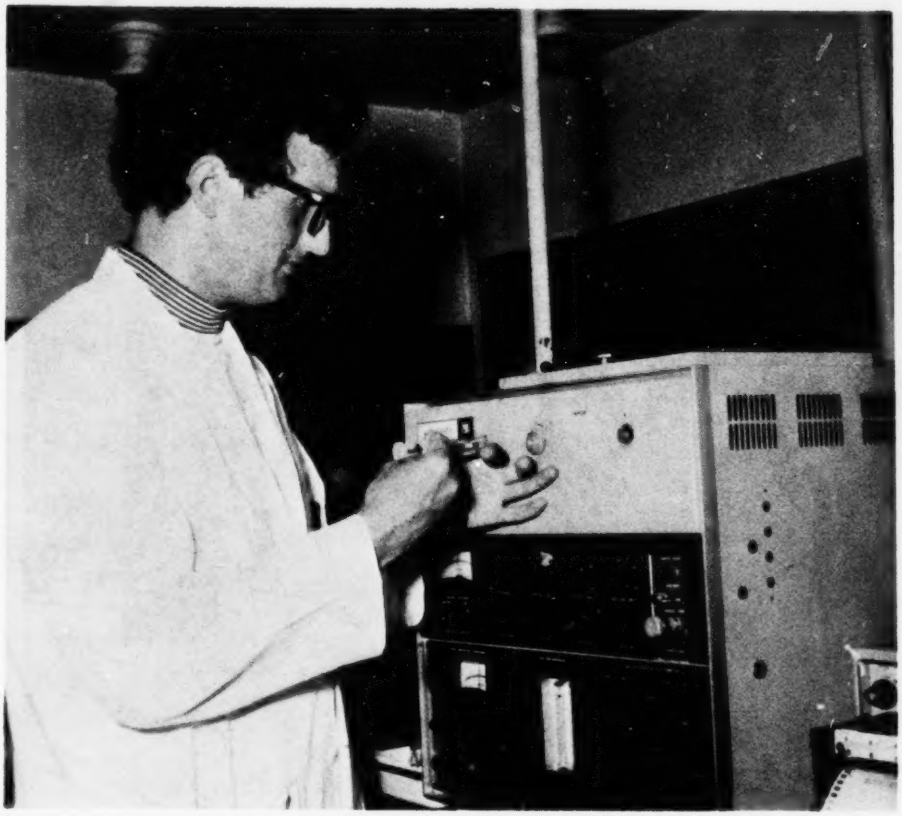

Figure 8 - Gas chromatograph and technician are pressed into vital analytical work on site within 6 hours after arrival on scene. (Courtesy Portsmouth Times)

Based on the success of the pilot plant as shown by the data in Table 3, the OSSC decided to see if enough equipment was available to construct a large scale treatment plant based on the design parameters verified by the pilot plant. By a search of EPA resources, the OSSC was able to locate a large cypress box built for a research project in water treatment methods. This container was of a suitable size for the Pond Lick treatment plant and the OSSC and Shawnee State Park personnel[1] were able to arrange immediate shipment of the box on Thursday night, June 17. The treatment system design was completed Thursday night and construction began at dawn Friday, June 18. Figure 9 shows the construction in progress. By Saturday evening the filter was finished and placed in operation. Several operational difficulties were discovered and corrected by design modification and operation over the next week.

Two types of trouble plagued the plant: first, fine carbon particles were washed out of the filter and were trapped by the material forming the top of the filter, which was a combination of vermiculite, clay and cloth. This was corrected by replacing the top with a wire screen assembly. The second problem was that of air drawn into the suction side of the supply pump which was a converted military fire pump. The air bubbles disturbed the carbon bed and allowed Endrin to short circuit untreated. This was reflected in effluent readings from the treatment plant, which is presented in great detail in Appendix F. The final solution to this problem was the installation of a submersible electric pump in the lake on June 23. The placement of the activated carbon filter plant is depicted schematically in Figure 10.

To increase the rate of treatment a second, gravity operated filter was built by damming the lower end of the spillway and letting water flow up through a bed of carbon in the bottom of the spillway near the stilling well. A treatment rate of about 400 gpm was maintained since early July using this scheme. Samples were taken regularly from the stilling well and analyzed by gas chromatography. If the Endrin level exceeded a value of 0.4 ppb in this pool, emergency procedures outlined in Appendix E, Notes on Operation Section, were put into effect. Table 4 below includes typical operation data for the pressure filter. More complete data is collected in Appendix F, Field Data. Figure 11 shows an Emergency Response engineer evaluating the flow and performance of the completed and installed filter assembly.

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[1] Mr. Everett Ridge, District Supervisor, Department of Natrual Resources, State of Ohio, and his staff.

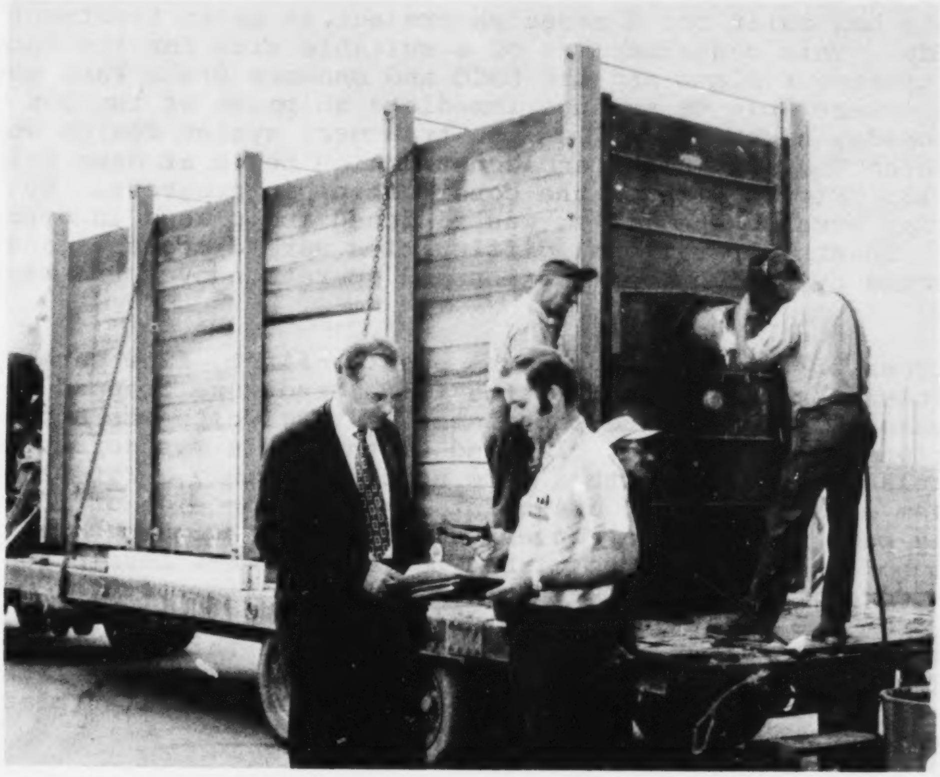

Figure 9 - The EPA On Scene Spill Coordinator and emergency consultant work on last minute details of prototype treatment plant while the cypress box to be used as a filter undergoes modification by State of Ohio workers at Pond Lick Lake. (Courtesy Portsmouth Times)

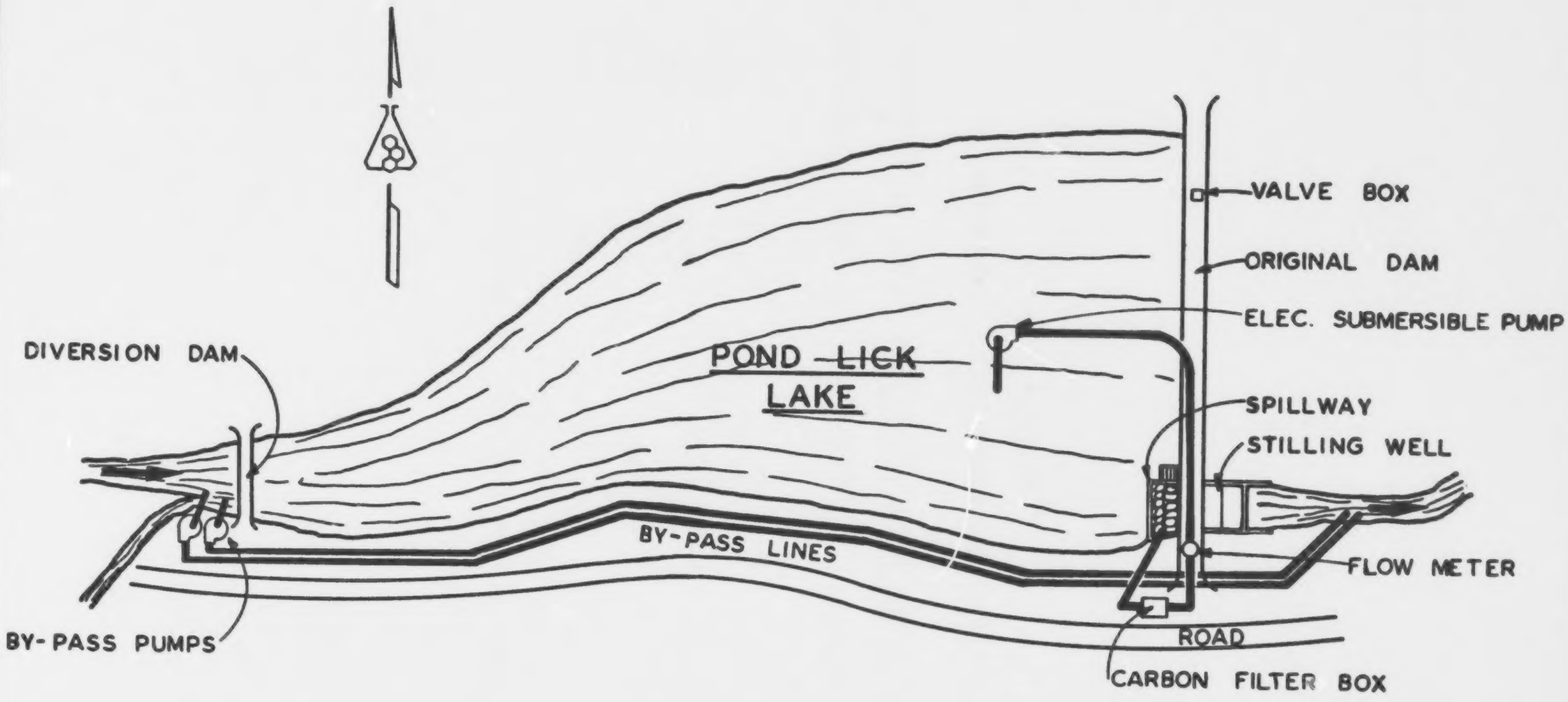
VALVE BOX
ORIGINAL DAM
ELEC. SUBMERSIBLE PUMP
DIVERSION DAM
POND LICK LAKE
SPILLWAY
STILLING WELL
BY-PASS LINES
FLOW METER
BY-PASS PUMPS
ROAD
CARBON FILTER BOX

FIGURE 10

PLACEMENT OF ACTIVATED CARBON FILTER PLANT AT POND LICK LAKE

TABLE 4

TYPICAL TREATMENT PLANT OPERATION

Date	Endrin Concentration (ppb)		Flow Rate	Number of Hours in Operation
	Lake	Effluent	(gpm)	
6/19	3.8	0	47	0
6/20	7.2	0	91	13.5
6/20		0.063	198	23.5
6/21	9.0	0.100	115	38.5
6/22	6.15	.65	118	63
* 6/24	7	.1	168	69
6/24	7	.03	168	75.5
6/24		.2	178	86.5
6/25		.28	169	90.5

* Submersible electric pump placed in operation

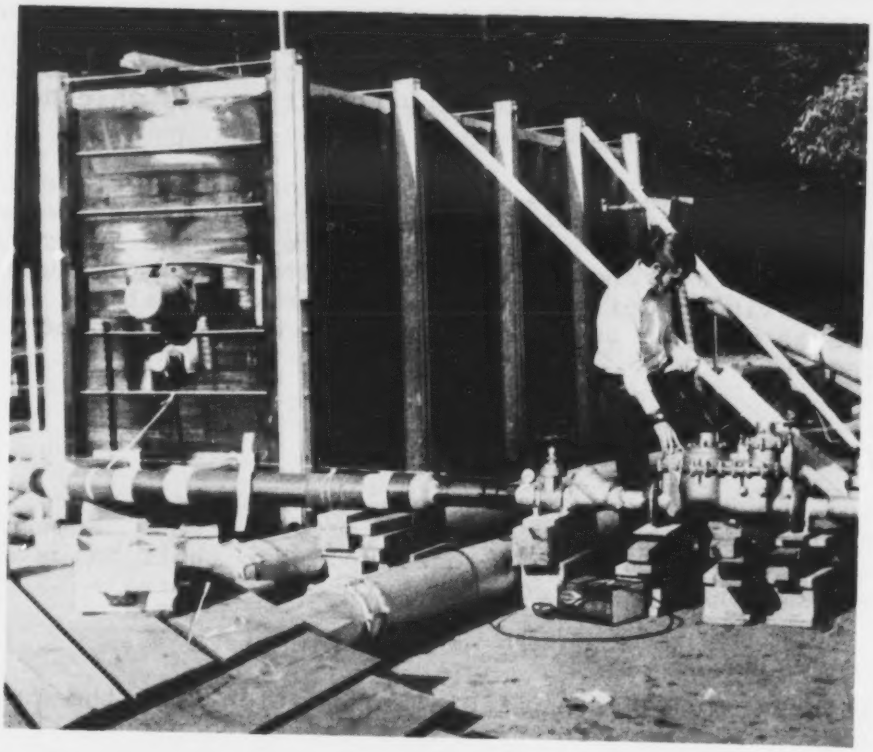

Figure 11 - EPA consultant checks the flow of contaminated lake water into the completed activated carbon filter assembly. Filter was placed in operation one week after EPA was notified of spill. (Courtesy Portsmouth Times)

EPILOGUE

The dispatch with which the State of Ohio, the U. S. Environmental Protection Agency and the Emergency Response Contractor investigated and resolved the hazardous spill emergency at Pond Lick Lake is a credit to the scientific and engineering capabilities and manpower and resource mobility of each organization. The cleanup and removal of Endrin proceeded carefully, thus eliminating any threat to the Ohio River and the surrounding populace.

During and following any such operation, however, certain improvements, modifications and unresolved issues become evident; these bear great significance for the future resolution of emergencies such as the incident at Shawnee. The following briefly summarizes those critical yet unresolved issues as well as suggested improvements to incident control procedures.

Unresolved Critical Issues

During the crisis period, several issues were raised which were discarded in favor of other alternatives. Some of these issues need to be focused upon for their value and use in preventing and controlling future incidents.

A. Ecological Recovery of Pond Lick Lake

It appears from the available information that the long-term ecological damage resulting from the strychnine will be minimal. Endrin, however, is a highly toxic chlorinated hydrocarbon pesticide with high toxicity to both fish and mammalian forms. Although it is a stereo isomer of Dieldrin, it differs from Dieldrin in that it has higher acute toxicity, it is more rapidly metabolized in plant and animal tissues, and it does not appear to be a persistent insecticide in vertebrates.[1] For this reason, it is possible that problems with biological magnification will be less with Endrin than would be the case with other chlorinated hydrocarbon pesticides.

In order to adequately assess these problems, it will be necessary to determine the present chemical, physical and biological characteristics of the tributaries into and out of the lake as well as the lake itself and the Endrin concentrations in water, mud, and the aquatic food chain over a period of at least one year.

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[1] Shell Technical Bulletin, Summary of Basic Data for Technical Endrin, Shell Chemical Company, San Romon, California and Jager, K.W., Aldrin, Dieldrin, Endrin and Telodrin, Elsevier Publishing Company, New York, 1970, p. 86.

Prior to the implementation of either the limited survey or the complete evaluation, it will be necessary to conduct preliminary studies to determine the overall nature of the physical environment and the biological community in order to best locate sampling sites and to determine those parameters which are most significant. A complete evaluation should be conducted according to the following outline.

I. Sampling Locations: Total of 8 locations; one above lake, two within lake, three in Pond Lick Run, two on Turkey Creek. Care must be taken to assure that the stream sites selected comprise similar aquatic habitats whenever possible.

II. Frequency of Sampling: Total of 6. One immediately after selection of permanent sites, one within one month, quarterly for a period of 1 year.

III. Determinations at Each Site:
   A. Pesticides: Analyses for pesticides should include determination of other chlorinated hydrocarbons as well as Endrin since this will provide available background information and does not greatly increase the time or cost involved in analyses.

      1. Water: From each stream station and during periods of stratification, from two to three depths within the lake.
      2. Fish: At each site as available for major species.
      3. Bottom Sediments: At each site.
      4. Periphyton and/or Macroinvertebrates: Nature of these samples will depend on the nature of the aquatic communities present.

   B. Chemical: The nature of chemical analyses to be routinely conducted depends on the quality of the water in the lake and its tributaries, and the nature of any pollutants which may be present. Routine analyses such as D.O., pH, Alkalinity, Hardness, Phosphate, Nitrate, Ammonia, and B.O.D. should be carried out.

   C. Biological: Biological studies should be conducted at each site. In addition to the specific studies described below, observations of other organisms and communities should be made during each sampling period in order to determine if additional effects of the Endrin pollution are evident and the overall pattern of recovery of the aquatic community.

1. Benthic Organisms: Samples will be taken at lake stations with a dredge suitable for the bottom type in question. Stream samples will be taken with a dredge or Surber sampler. The kinds and numbers of organisms present will be determined. Samples from similar habitats will be compared for composition, number and diversity.
2. Plankton: Samples for plankton studies will be collected and concentrated by means of the plankton centrifuge and examined to determine the kinds (to genus) and numbers of organisms present.
3. Periphyton: At each site, if available, for composition only.
4. Fish: At each site if possible. Collections will be made by seine hauls, gill nets or shocking, depending on conditions. Determinations as to kinds, numbers, and age class should be made.

B. Alternate Countermeasures

Several promising alternate treatment schemes were proposed but ruled out due to the lack of reliable design information in the literature or immediate feasible implementation. These alternate countermeasures are presented in great detail in Appendix D. Some of these, such as barging the poisoned water to sea, would be too expensive to consider seriously, but several materials were proposed for in-place treatment of the lake. Powdered activated carbon, fly ash, bentonite, and topsoil or peat were mentioned for this purpose. Simple jar tests performed at the site could have established the usefulness of any or all of these materials if reliable design and scale-up factors existed in the literature. The economics of each of these alternatives appears to be extremely favorable and should be compared with the activated carbon filter system built. Since the geological report showed no likelihood of ground water contamination, a system of sinking the Endrin to the bottom might be desirable.

An issue which was to be resolved was what should be done with bottom muds containing Endrin. If the sides were scraped perhaps the best place to put the muds is in the bottom of the lake. The bottom could be sealed with a layer of bentonite or fly ash. Perhaps these materials would absorb any Endrin which desorb from the muds. Resolution of this issue would relate to the ecological recovery program presented above.

The last, and perhaps most important issue, is the alternate method proposed which would let the lake recover naturally, Allowing natural recovery would not only be inexpensive, with the cost dependent upon monitoring used, but it would be extremely useful in gaining knowledge of how recovery occurs so that predictions could be made about a larger lake or river which could not be treated. The remoteness and geological isolation of this lake made it an ideal area for study.

Critique of Response Actions and Recommendations

During the course of the emergency spill cleanup operation, it was recognized that certain improvements and modifications could be made to the spill incident control procedures. These suggestions are presented as follows:

1. Working within existing state organizations, all states should designate an Oil and Hazardous Materials Branch with responsibility to coordinate state response and to interface with U. S. Environmental Protection Agency (EPA) programs and On Scene Spill Coordinators.

2. Correspondence and lines of communication should be opened between these State agencies and the U. S. Environmental Protection Agency. This project required a great deal of cooperation between State, Federal, and private individuals to accomplish the objective of removing the Endrin as expeditiously as possible. Without cooperation the project could not have succeeded. Under conditions such as these a close working rapport is necessary in the field.

3. A Spill Response Notebook or Damage Assessment Manual should be developed by the U. S. Environmental Protection Agency, for distribution and use by various concerned agencies and organizations.

4. These notebooks, along with an explanation of the full breadth of the U. S. Environmental Protection Agency program should be presented in a series of seminars to the designated State teams.

5. Field Preparedness Package

To allow rapid mobilization of the Emergency Response Contractor, a field preparedness package should be maintained by the contractor at all times. This unit would contain: slide rule, notebooks, engineering handbooks, Damage Assessment Manual, and Polaroid camera. The field preparedness package should possibly contain sampling equipment and containers similar to those used by the Contractor. These containers allow refrigerated samples to be sent by air anywhere in the world simply by using insulation material. This field preparedness package is not thought of as a complete portable lab, but rather a "first-aid kit" which will make the initial response a more efficient operation.

6. Manpower Scheduling

In an emergency such as that created by a spill of Endrin there is an optimum number of personnel to send to the site to effect remedial action. The area affected by the spill and the degree of danger to humans, wildlife, and livestock in the area will dictate the level of manpower required and the duration of their stay. The Contractor recommends that one senior level engineer or principal representing the Emergency Response Contractor and one Project Officer representing the U. S. Environmental Protection Agency be dispatched to the scene prior to authorization of support services. Based upon their review and on-site evaluation, the level of technical response should be authorized. To support the response team on significant spills, one clerical level person should also be sent. This person will be available to answer telephones, relay messages, type, and correlate the field notes of the professionals.

7. Effective Coordination and Project Communication

a. To effectively assess the damage caused by a spill of this nature, the Emergency Response Contractor operates in two areas. The field team on site relies heavily on the activities of the home office staff for support information. This is a good concept but to work efficiently, it requires excellent communications; thus the suggestion above for clerical support in the field. Limited telephone facilities in the field and large distances between the phones and the site of the spill made communication at Pond Lick Lake unreliable. In the event of future spill incidents, the telephone company should be requested to immediately install adequate telephone service at the field site, or portable equipment, i.e., radios, etc. EPA should plan for these devices in future remote areas.

b. Release of information to the public should be handled in a manner which will dispel rumors and misconceptions. This can be most effectively accomplished by establishing an on-site press office manned by designated EPA and State officials. The Contractor should have no contact with the press unless the OSSC asks for assistance or approves a press release.

Incident at Shawnee: Its Significance

The importance of the unresolved critical issues and the suggested improvements to the incident control procedures cannot be underestimated. In retrospect, however, these are relatively minor concerns. The element most crucial to the resolution of the problem was the human response which the emergency spill necessitated. A basic concern for the health and welfare of the populace in the surrounding area motivated the initial efforts of the State of Ohio and the subsequent actions taken by the U. S. Environmental Protection Agency and the Emergency Response Contractor. It is essentially this human element which led The Portsmouth Times[1] to say:

"We can take great pride in the response of the many agencies concerned with clearing the lake of the poison. We can take pride in the fact that the discovery came early enough to prevent harm to persons who use the lake. We can take pride in the efforts of every individual concerned with the action in any way."

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[1] The Portsmouth Times, Monday, June 21, 1971, p. 6. For additional newspaper references to the emergency spill, see Appendix G.

APPENDIX A

Chronology of Project

This Appendix includes:

1. Exhibit A. Statement of Work from EPA/Washington to RETA authorizing Contract No. 68-01-0045.
2. Exhibit B. Chronology
3. Exhibit C. Critical Decisions

Exhibit A

Statement of Work from EPA/Washington to
RETA authorizing Contract No.

Background

On June 2 or 3, approximately one (1) gallon of a mixture of concentrated pesticide (18.6% Endrin) and strychnine treated corn was dumped into Lake Shawnee (area three (3) acres) in Shawnee State Park. Shawnee State Park is about ten (10) miles southeast of Portsmouth, Ohio. Mr. Roach of the Department of Natural Resources of Ohio asked for help from the Environmental Protection Agency (EPA), Chicago, Thursday, June 10. Because of the imminent and substantial threat to the Ohio River and downstream users thereof, EPA response was required. Mr. Andy Sidio of the National Field Investigative Team (NFI) of Cincinnati responded June 10 and took samples of the lake and receiving stream Pond Lick and Turkey Creek. 6800 lbs. of .40 mesh activated carbon were broadcasted by Mr. Sidio's crew across the surface of Lake Shawnee. Mr. Robert Cantor dispatched Wheeling, West Virginia, Regional Oil and Hazardous Material Personnel to aid and/or relieve Mr. Sidio and the NFI, June 12, 1971.

Task to be Performed

The emergency Response Contractor was activated and, if accepts, will undertake to accomplish the following:

1. Provide Mr. Sidio and other EPA personnel on-scene with immediate (June 12, 1971) technical advice, by phone, on adequacy of existing activated carbon treatment or suggested modifications thereof and advise on other alternative countermeasures;

2. provide Mr. Sidio or other EPA personnel on-scene with technical advice once the Contractor is on-scene (June 13, 1971);

3. undertake limited downstream observations to supplement the work already underway by the NFI, June 13-15, etc; and

4. collect sufficient technical information and photographs to prepare an incident report dealing with the cause, effectiveness of countermeasures, timeliness of response, short-term and long-term effects of the discharge, and steps that may be taken in the future to prevent such a discharge. This report is due to the Project Officer in Washington, D. C., July 15, 1971.

Exhibit B

Chronology

The following table outlines the daily activities of key personnel of the States of Ohio, the U. S. Environmental Protection Agency, and Ryckman, Edgerley, Tomlinson and Associates (RETA) throughout the project from the initial spill of Endrin to notification and activation of the State/Federal response team and subsequent design, construction and operation of the prototype treatment plant.

The sequence of events for each day are listed under the group most responsible for them. By studying the chart, the progress of the project can be followed and the contributions of each team member ascertained.

Exhibit C

Critical Decisions

In anticipation of an incident similar to the one reported here, the Division of Oil and Hazardous Materials of EPA had set up an agreement with RETA to provide technical assistance and support to EPA to minimize damage to the environment by a release of hazardous materials. The extremely rapid rate at which a solution to the problem was reached and implemented is a compliment to all who participated and to their ability to work together under trying circumstances. The activities at Pond Lick Lake were directed by a cooperative team consisting of the U. S. En-

SEQUENCE OF EVENTS

	Wed. June 2	Thursday June 10	Friday June 11	Sat. June 12	Sunday June 13	Monday June 14	Tuesday June 15	Wed. June 16	Thursday June 17	Friday June 18	Sat. June 19	Sunday June 20	Monday June 21	Wed. June 23	Thursday June 24	Friday June 25	Sat. June 26	Monday June 28
OHIO	Poison dumped in lake in Ohio	DNR asks EPA for assistance	Spillway dammed	Diversion dam started Activated Carbon on lake	Finish diversion dam Begin by-pass Raise Sandbags Post guard around lake	Raised dam Built by-pass Set up pumps	Formal assistance request sent to EPA W. Nye, meets CHT in travel to site	Power installed at dam W. Nye locates G. C. at O.S.U. Build pilot plant	2:a.m. G. C. arrives at dam with D. Howard Telephone installed at site	G.C. analysis shows good pilot plant operation Build prototype plant	Complete prototype plant	Modify filter Dave Howard briefed on safety Dave Howard briefed on safety	State to pick up as EPA pulls out	Electric submersible pump ordered to stop air bubbles	Electric Pump Operation 2:30 p.m. No air in filter	Heavy rain, lake level rises 18"	Conditions stabilized Construction of emergency spillway filter begins	Filter and spillway filter operate to 400 GPM
EPA		EPA notified National Field Team to scene	Bioassay Fish die 2 hours G. C. sample to Cinn. Dam spillway	C. H. Thompson notified Information gathered National Field Investigative Team input to Hazardous Materials Branch	Bioassay & Chemical analyses Stream damage survey. Suggest stop using wells in area.	Depth samples taken, temperature profile C. H. Thompson receives report	CHT to Columbus meets with DNR travels to site CHT decides pilot plant needed Comprehensive sampling program requested	CHT attempts to locate EPA carbon filter plants. All are in use CHT works to find GC	2 a.m. CHT, D. Howard set up G.C. Results at 10a.m. pilot plant working CHT locates tank for prototype plant Decides to build prototype based on pilot plant success	6 a.m. Repairs Pilot Plant CHT directs construction of prototype	Construction continues Plant in operation 5:30 p.m Air bubbles in filter cause problems shut down prototype plant	Modify filter CHT leaves Dave Stoltenberg in charge				Conference CHT about heavy rain conditions		
RETA				RETA notified Accepts job	RETA to field from Dayton & St.Louis Assess damage Recommend no more carbon	Prepared situation report, delivered to CHT Second report sent	Design Pilot Plant, start construction	Build pilot plant Pilot Plant Operation begun at 10:30p.m.	Operate and sample pilot plant Begin design calculations on prototype plant	Detailed Construction description by SJR		Modify filter Restart	Filter Modifications with state Need for 24 hour operators noted	Operating & emergency proceedure instructions created				

TABLE 2

KEY:

DNR	Ohio Department of Natural Resources
EPA	Federal Environmental Protection Agency
RETA	Ryckman, Edgerley, Tomlinson, & Associates
CHT	Dr. C. H. Thompson
SJR	S. J. Ryckman
G.C.	Gas Chromatograph

vironmental Protection Agency, the State of Ohio and Ryckman, Edgerley, Tomlinson and Associates (RETA).

Pond Lick Lake is a small lake of approximately three acres surface area and a length of about 1,000 feet. The depth is 35 feet maximum and an average of approximately 15 feet. The volume is approximately 15 million gallons. The shore characteristics are regular with steep banks and no swampy zone.

The lake was formed behind a dam built during the depression by CCC labor groups. It served as a reservoir for an honor camp of the Ohio penal system until it was closed a few years ago. The current use is recreational, with fishing and limited boating. The lake and its watershed are located in Shawnee State Park about seven miles southwest of Portsmouth, Ohio, some 110 miles from Cincinnati and 100 from Columbus.

The lake is used for fish, aquatic life and wildlife. The affected population living downstream from the lake before it flows into the Ohio River is between 50 to 200. There were four or five wells threatened, according to the Ohio National Resources Division.

In this section of the report we have attempted to collect the critical decisions which were made and which controlled the direction of action by the team. These decisions are as follows:

1. State of Ohio Requests U. S. EPA Assistance.
   The State of Ohio Department of Natural Resources asked the federal EPA for help June 10 due to the threat of Endrin poison entering the Ohio River. An EPA team, under the leadership of Andy Sidio of the Cincinnati Field Investigative team, responded June 10. Mr. Sidio assessed the initial damage and through the Wheeling, W. Va. EPA field office contacted Dr. C. H. Thompson, Chief, Hazardous Materials Branch, Water Quality Office of EPA in Washington.

2. Ohio Takes Steps to Contain the Lake.
   An initial decision was made by the Ohio Department of Natural Resources to contain the lake by sandbagging the spillway and building a diversion dam and by-pass at the head end of the lake to isolate the entire lake. Approximately 6,800 pounds of granular (40 mesh) activated carbon was spread on the lake. This did not significantly reduce the Endrin concentration because it settled to the bottom too fast to contact a significant amount of Endrin.

3. EPA Activation of RETA Response Team.
The initial contact with RETA was made at 5:30 p.m. on June 12, 1971 (Saturday) by Dr. C. H. Thompson, of the Environmental Protection Agency, in a telephone call to Dr. G. M. Barsom. Dr. Thompson is Chief of the Hazardous Materials Branch, Water Quality Office, EPA, Washington. This telephone conversation reported preliminary information available on the spill of Endrin and strychnine into Pond Lick Lake in Shawnee State Forest near Portsmouth, Ohio.

RETA personnel had several conversations with Dr. Thompson concerning the EPA Contract 68-01-0045, its activation, and the preliminary information transfer.

Mr. John Blake, EPA Contract Officer, held a contractual discussion with D. W. Ryckman, RETA President, and requested a preliminary cost estimate.

At 7:30 p.m., a conference of key RETA staff was held to discuss preliminary evaluation and proposed action. A decision was made by the staff to accept the assignment. This acceptance of the assignment was made in a telephone conference call between D. W. Ryckman, G. M. Barsom and C. H. Thompson at 9:30 CST. Additional information on the scope of work was transmitted at this time.

At 11 p.m. a conference call was held between G. M. Barsom, D. W. Ryckman and S. J. Ryckman (Dayton, Ohio) with Mr. Sidio. There was a two-hour discussion of the situation, action to date, the recommended course of action, and the schedule verification of participants.

During Saturday night and into the early morning hours of Sunday, the RETA staff made manpower allocations and mobilized field equipment. Schedules for transportation were assigned, and at 7:00 a.m. CST the RETA team was dispatched to the field from St. Louis and Dayton.

At 11:00 a.m. Sunday the 13th of June, the field crew called the St. Louis office to say they were leaving the motel to meet with the EPA and State of Ohio men on the site. Contact was made at the site by Mr. S. J. Ryckman from Dayton, and Dr. C. Lue-Hing and Mr. W. E. Anderson from St. Louis with Mr. A. Sidio, EPA, and Mr. Redett, State of Ohio.

4. RETA Makes First Observations and Recommendations.
RETA field personnel endorsed the isolation of the lake and sandbagging to raise the height of the spillways.

RETA recommended that no more carbon be spread on the lake until its effectiveness to sorb the Endrin and its effect on the lake biota and groundwater could be determined. Federal and state officials agreed and no granular carbon was spread in the lake after June 12.

Spill definition information was gathered and transmitted to the St. Louis office. Isolation of the lake by the Ohio Department of Natural Resources was largely completed on Sunday and sample locations on the lake and downstream were established. The RETA team discussed possible treatment of the spill with Mr. Redett.

Dr. Thompson called the RETA office Sunday afternoon and was given tha status of the project. Arrangements were made to deliver Situation Report No. 1 (see Appendix B) to him in Denver on Monday at the Annual AWWA conference. Sunday evening, S. J. Ryckman, RETA Field Manager, was contacted for information for the first report. Following is a summary of Situation Report No. 1.

A. Spill Definition

As nearly as can be determined, on June 2, 1971, a one gallon plastic container filled with approximately one gallon of Endrin mixed with corn kernels soaked with strychnine (rat bait) was dumped into Pond Lick Lake in Shawnee State Forest, Portsmouth, Ohio, by an irate citizen.

According to the manufacturer's specifications, the Endrin was a wettable emulsion in an oil based dispersing agent, 18.6% by weight Endrin, 73% by weight petroleum hydrocarbon and 8.4% by weight inert. Between 1/2 to 3/4 gallon of Endrin is believed to have been in the bottle. The wettable Endrin emulsion rapidly goes into suspension in water and by the time the spill was discovered, had mixed with all the surface waters of the lake. Samples were analyzed by Friday, June 11 in Cincinnati by the Environmental Protection Agency. Endrin was reported as 8.5-9.5 ppb by these tests. This figure was in agreement with bioassay data.

The strychnine (0.05-1.0%) was in insoluable form on dried corn, which amounted to approximately 1/2 gallon. This caused little damage to the environment since strychnine breaks down when exposed to sunlight and was not a matter of great concern throughout the incident.

The public was warned of the polluted water by radio, television and newspaper, signs saying "Poisoned Water" posted around the lake and downstream and 24 hour patrols guarded the lake. The access roads were closed during the entire period after the discovery of the spill and continue to be closed as the lake is being pumped dry.

No hazardous polluting substance was spilled after the lake outlet was sandbagged on Thursday, June 10th. Before that the substance had travelled downstream approximately 1 mile. After the lake was sandbagged, the water was contained in a concrete dissipating basin and recycled into the lake by a pump.

B. Ecological Damage

The apparent ecological damage is as follows:

1. There were approximately 3,500 dead fish, both in the lake and downstream. They were mostly blue gills, bull heads and catfish and were killed within a few days as the Endrin spread.
2. About 3,400 fish were estimated to be dead in the lake. A downstream survey showed a complete kill for 0.2 miles below the dam, heavy damage with most forms of aquatic life dead in the 0.2 - 0.6 mile region, recovery in the 0.6 - 1.0 mile stretch and no apparent damage at distances of greater than one mile.
3. A muskrat was caught after swimming in the lake, and shipped to the State Health Department in Columbus for observation. The muskrat died.
4. Two dead opossums were reported by one of the men representing the State of Ohio.
5. Several types of large and small fish - perch, catfish, sucker - have been observed alive at intervals since June 2.
6. On June 18, a snake was seen swimming in the water by the spillway. Some sick bluegills were seen the same day, also some frogs swimming near the surface.
7. Mr. Gilbert Helwig of the Ohio State Department of Natural Resources reported seeing two couples swimming from the dock at the lake on June 8, 1971. He told them the lake was poisoned and that they should get out. He did not get their names. Another employee of the Ohio DNR reported chasing several people away who were swimming in the lake. The total seen swimming was about twelve. No names were given. Mr. Helwig later heard a rumor that a boy was in University

Hospital, Columbus, Ohio, badly swollen, who claimed to have gone swimming in the lake.

Construction of a diversion dam across the upper end of the lake was progressing well and completion was to be achieved Sunday night. Light, intermittent rain was falling and continued to fall for several days. The pumping system to convey the diverted water around the poisoned lake was completed on Monday, June 14. This system was designed as a temporary device to try to protect the lake if rain occurred in the area. Ohio Department of Natural Resources stressed the importance of immediate action due to the limited capacity of this system and its temporary nature.

The watershed above the lake is about 4 1/2 square miles but the area receives frequent heavy showers; in summer, there may be 2 to 4 inches of rain at one time.

It is fortunate that no heavy rain occurred between the time of the spill and construction of the dam eight days later. A heavy rain then could have pushed a large amount of the poisoned water over the spillway and into the Ohio River. A rain gauge was installed later and recorded over 2 inches of rainfall on Friday, June 25.

On Monday, June 14th, Situation Report No. 1 was delivered to Dr. Thompson in Denver by E. Edgerley, RETA Senior Vice President. William Nye, Division of Water Resources, State of Ohio, expressed a need to meet with Dr. Thompson. A flight schedule was arranged by RETA staff so that Dr. Thompson could meet with Mr. Nye on Tuesday morning in Columbus, Ohio.

Situation Report No. 2 was written Monday, showing that the contaminated lake water was not a threat to ground water. Published standards for Endrin toxicity to aquatic life were contained in this report.

5. Pilot Plant is Needed

The failure of the initial spreading of the carbon to reduce the Endrin concentration raised the need to comprehensively evaluate other possible counter measures, (Appendix D). Tuesday evening, June 15, the decision was made to construct and operate a pilot plant to determine:

a. Ability of an activated carbon column to remove Endrin and produce a non-toxic effluent;
b. Adsorptive capacity of activated carbon;

c. Necessary loading rates for proper carbon contact and Endrin adsorption;
d. How to best construct a filter system;
e. Whether a pre-filter was needed to remove suspended material.

Dr. Thompson made the decision to use a pilot plant in order to quickly verify the information needed. Other counter measures (detailed in Appendix D) were evaluated and ruled out either because of process or construction short comings or because a long time was required to establish the validity of the process. The Ohio Department of Natural Resources and RETA cooperated in designing and building the pilot plant. A crew worked all night Tuesday, June 15 with RETA engineers to construct the plant. The pilot plant went into operation Wednesday, June 16. Dr. Thompson and S. J. Ryckman were at the pilot plant when the gas chromatograph arrived from Ohio State University. Dr. Thompson immediately turned to the installation of the instrument as noted below.

6. Portable On-site Gas Chromatograph is Needed.
One of the first areas recognized as a potential trouble spot by the RETA team on Sunday, the 13th of June was that of sample analysis. Dr. Cecil Lue-Hing of RETA expressed the desirability of an on site Gas Chromatograph to allow rapid analysis of samples. On Sunday, samples were being sent to Cincinnati for analysis, a workable arrangement for defining the problem, but not for monitoring and controlling the treatment system. RETA relayed the request to Dr. Thompson. Dr. Thompson was attending the AWWA meeting in Denver and discussed the need with other conferees. Several leads emerged from the discussion. Ohio State University was a possible source as was EPA in Wheeling, West Virginia, Cincinnati, Ohio and Chamblee, Georgia. Dr. Thompson, John Cox, John Blake and Dr. Aron Rosen, all of EPA, spent a great deal of time in trying to locate an available unit, without success. All of the EPA units were in use on research projects and unavailable for the Shawnee Lake Operation. Dr. Thompson and Director Nye discussed the need and Mr. Nye worked with Ohio State University to provide an instrument and an experienced man to run it. Finally Mr. Nye sent word the 16th of June that the instrument was available.

7. Decision to Build Prototype Plant
The pilot plant was successful in removing Endrin from the lake water at its design loadings as shown by early gas chromatography of effluent samples and fish bioassays. The next decision was to try to build a

prototype plant capable of treating large amounts of water.

A critical factor was locating equipment available to build the plant which would meet the design criteria established by the pilot plant, or which could be modified to do so in a short time. Dr. Thompson, through EPA in Cincinnati, found that some large cypress tanks were in storage at Cincinnati. Size estimates allowed a rough calculation of capacity, which was found to be suitable. Dr. Thompson flew to Cincinnati to inspect the tanks, found them satisfactory and ordered the prototype plant designed using locally available supplies such as PVC drain pipe. The plant went into operation Saturday, June 19. Details of its construction and operation are given in Appendix E. On Sunday, June 20, certain problems developed and some redesign was required.

8. Prototype Modifications
The top of the filter was originally designed with a layer of vermiculite to allow expansion of the carbon bed. This material broke down and clogged a muslin cloth designed to stop carbon fines from escaping. The top of the filter was redesigned to eliminate both the muslin and vermiculite. This helped operation but air being drawn into the pump supplying the filter caused channeling of the bed. A submersible pump was installed instead of the original gasoline pump to stop the flow of air into the carbon filter. The filter has been operating successfully since that time. Samples are periodically taken and analyzed with the gas chromatograph (G.C.) to ensure that Endrin is not discharged to the receiving stream.

APPENDIX B

SITUATION REPORTS, ENDRIN/STRYCHNINE HAZARDOUS POLLUTING SUBSTANCE SPILL

The absence of documented information about the hazardous spill emergency coupled with the poor communications system in the vicinity of Pond Lick Lake necessitated a means should be devised to provide reliable and factual information to all involved. This included the State of Ohio field team and headquarters personnel, personnel from two Environmental Protection Agency Regional offices, and RETA field team and headquarters personnel. Thus, RETA initiated the use of situation reports to communicate the most current and accurate information regarding the spill and vital to its resolution. These reports proved essential in guiding and supporting the decision making process and in communicating the nature of the spill to the Congrees of the United States and to the general public. Two of the most essential situation reports are presented as follows. The first one was delivered to Environmental Protection Agency headquarters in Washington, D.C. and to Dr. Hugh Thompson in Denver within 48 hours of RETA project activation.

STRICTLY CONFIDENTIAL

Situation Report No. 1

RETA No. 862-1

TIME PERIOD:

From: 5:30 pm 6/12/71

To: 11:30 pm 6/13/71

TO: Dr. C. H. Thompson
Environmental Protection Agency
1921 Jefferson Davis Highway
Arlington, Virginia 22202

FROM: Ryckman, Edgerley, Tomlinson and Associates, Inc.
500 Coronet Building
225 S. Meramec
St. Louis, Missouri 63105

ENDRIN/STRYCHNINE HAZARDOUS POLLUTING SUBSTANCE SPILL

SHAWNEE LAKE
PORTSMOUTH, OHIO

RETA 862-1

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X NOTES . . . .

I. EVENTS LOG

Date	Time (Nautical time)	Event
6/12/71	1730	C. H. Thompson, EPA, called G. M. Barsom, RETA, to report preliminary information available on spill of endrin and strychnine.
	1830	C. H. Thompson to B. N. Sampley, report pending activation of B.O.A.
	1900	C. H. Thompson to D. W. Ryckman, activation of B.O.A. preliminary information transfer.
	1915	J. Blake to D. W. Ryckman, contractual discussion. Request for preliminary cost estimate.
	1930	Conference of key RETA staff: G. M. Barsom, D. W. Ryckman, E. Edgerley, H. D. Tomlinson, Ralph Clark, Joel Harrod, Cecil Lue-Hing, Jim Chaney, Joe Dieterman, Russ Tirella. Preliminary evaluation and proposed action.
	2030	Joel Harrod call to Weather Corporation for present and forecasted weather in the damage area. Intermittent thundershowers.
	2200	D. W. Ryckman, G. M. Barsom telephone conference with C. H. Thompson. Transmittal of additional information on scope of work.
	2230	C. H. Thompson call to A. Sidio (EPA, Cincinnati, man-on-site)
	2300	Conference call by G. M. Barsom, D. W. Ryckman and S. J. Ryckman with A. Sidio. Two hour discussion of situation, action to date, recommended course of action, schedule verification of participants.
6/13/71	0130	G. M..Barsom, D. W. Ryckman conference regarding schedule, manpower allocations and mobilization.
	0200	H. D. Tomlinson, Joe Dieterman, Bill Anderson, Jim Chaney to RETA laboratory and warehouse to mobilize field equipment.
	0300	G. M. Barsom final schedule verification, manpower allocation and mobilization.

Date	Time	Event
6/13/71	0100 - 0300	RETA planning meeting.
	0700	RETA team dispatched to field from St. Louis and Dayton.
	1030	RETA strategy sessions begin.
	1100	Contact from field crew leaving motel base to meet with EPA, State men on site.
	1200	St. Louis (DPC) contacted EPA (Cincinnati) for background. Dr. Rosen gave basic information on concentration 8.5-9.5 ppb. use of activated carbon. Rough size of lake, depth, sandbagging of spillway.
	1315	SJR report from field. Confirmed Dr. Rosen's information. Indicated work proceeding on diversion dam at head end of lake; expect it finished by tonight. Strychnine not the problem due to its inclusion on corn and low concentration.
	1345	Dr. Hugh Thompson called; given status of project. Told us his plans to go to Denver and to go to field Tuesday. E. Edgerley to deliver report to H. Thompson in Denver Monday. Effect on ground water discussed. Need for carbon samples from the bottom discussed.
	1800	Information form assembled.
	2138	Contacted S. J. Ryckman for updated report. Information on Report I transmitted.

II. PERSONNEL

1. EPA/Washington Headquarters:

   Project Officer: Dr. C. H. Thompson

   Alternate: Mr. Russ Wyer

2. RETA Personnel (Name, Title, Function)

   Headquarters:

   1. G. M. Barson
   2. D. P. Clement
   3.
   4. Support: S. J. Clement, Geologist

   Field:

   1. S. J. Ryckman
   2. Cecil Lue-Hing
   3. Wm. E. Anderson
   4. Support:

3. EPA/Field Personnel (Name, Title, Function)

1.	Angell Sidio	Cincinnati - Cinti group chief
2.	Dick Daun	in charge Cinti group in absence of A.S.
3.	Nelson Thomas	Chief Biologist
4.	Mr. Griffith	Wheeling, W. Va. Biologist - sampling

4. State Crews: (Name, Title, Function)

John S. Barrett, Asst. Chief Eng. Dept of Wat. Resources
Supervise upstream damming and diversion
Dan Armbruster, Chief Div. of Wildlife, Dept.of Wat. Res.
Everett Ridge, District Supervisor, Div of Wildlife, Dept. of Wat. Res.
Mr. Toss, Coordinator of Parts
Robert Redeft, Wat. Resources - cleanup

III. SPILL DEFINITION

Date: 6/2/71

Time:

Location: Shawnee Lake, Shawnee Lake St. Park, Portsmouth, Ohio

SUBSTANCES SPILLED	QUANTITY
Strychnine (0.05-1.0%) on corn (rat bait)	1/2 gallon
Endrin WE (Wettable emulsion) 18.6% by wt.	3/4 gallon
73% by wt. petroleum hydrocarbon 8.4% by wt inert	

How Spilled: Dumped from 1 gallon plastic bottle into the lake by irate citizen. Attempted to sink bottle by hitting it with rocks. Bottle recovered (date of recovery unknown).

Affected Area: (Describe and sketch)

Surface Area: 3 acres

Depth: 35' maximum Average: 15 ? Range: 35-0

Volume: 15×10^6 gallons

General Topographic Features:

Shore Characteristics:

Regular - steep banks. No swampy zone

Estimated Water Shed Area:

III. SPILL DEFINITION (Continued)

Designated Water Use

___ Potable
___ Recreational
_X_ Fish, aquatic life & wild life
___ Agricultural
___ Industrial

Affected Population: 50 - 200 (estimates vary)

Affected Water Supplies (Surface, Ground):
4 - 5 wells threatened
Ohio Nat. Res. Div sending well logs 6/14/71

Hazardous Polluting Substances going over Spillway:
_X_ Contained in concrete energy dissipating basin
___ Not contained

Public Warning System:
_X_ Radio - TV - Newspaper
_X_ Signs - Poisoned Water
_X_ Patrols - 24 hr guard suggested by SJR implemented by Angell Sidio
Access roads closed.

Presence or absence of livestock
None noted by field crew.
Some along Turkey Creek.

Apparent Ecological Damage:
_X_ Fish 3400 dead fish removed - 50 still floating, blue gills, bull heads, catfish.
___ Wildlife
_X_ Aquatic Life - frogs
___ Other
Fish buried in polyethylene bags

III. SPILL DEFINITION (Continued)

Apparent Movement and Dispersion of Hazardous Polluting Substance:

Sketch area -- Maps at end.

Define affected zones (1) Lake - apparent complete kill; (2) 0-0.2 miles below spillway - complete kill; (3) 0.2-0.6 miles below spillway - damage, sick fish, great effect; (4) Below 1 mile, aquatic life appears normal.

Dominant mechanism of diffusion

☐ Molecular

☒ Turbulent (wind)

☒ Mass transport - Stream flow now blocked by sand bags on spillway

Quiescent pools - On shale bedrock downstream from dam

Aerial photos - No

Characteristics of Receiving Stream:

Size: Small

Depth: 0"-6"

Width: 6"

Velocity: Very slow - 20-30 gpm flow

Rapids: No

Turbidity: None

Shore line: Normal

Bank condition: Solid

Water appearance:

Observable damage:

Property: None

Life: Dead and sick fish and frogs as above.

III. SPILL DEFINITION (Continued)

Known Characteristics of Hazardous Polluting Substance:

Solubility: Endrin insoluble. Wettable emulsion disperses easily.

Structure:

Physical: } Toxic vapors if heated to decomposition
Chemical: }

Biological: TL_{100} 96 hr. 0.6 ppb (blue gills)

Ecological:

Toxicity:

Man: Enter via skin contact - 10 mg/kg orally cause sickness

Other life forms:

Health:

Estimated time available for designated action:

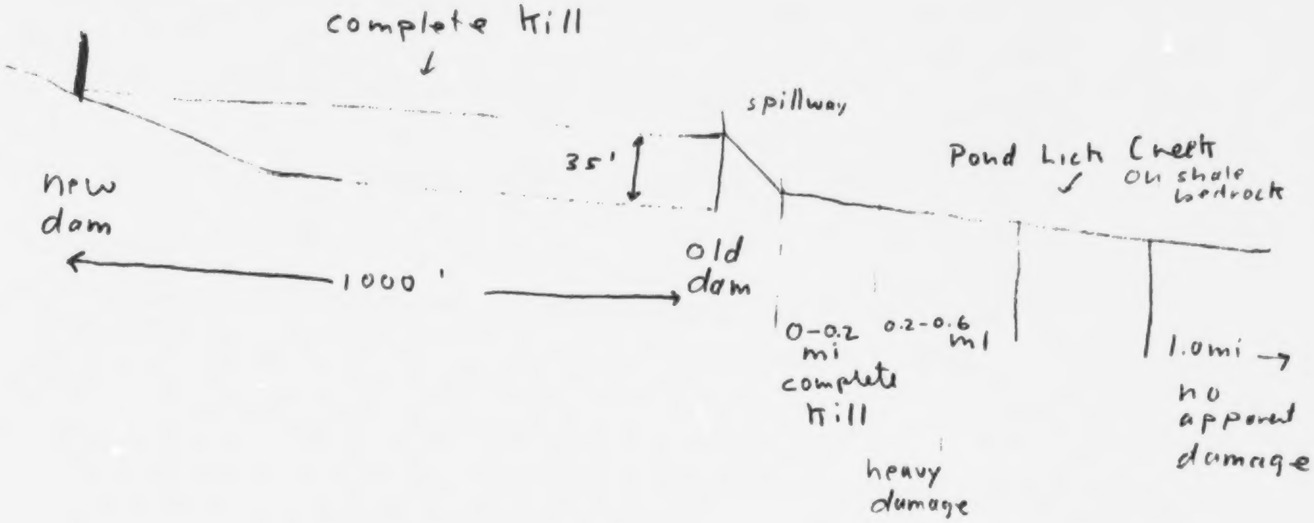
Time available 2 weeks - solution required 1 week

Designated Action: Filter through activated carbon

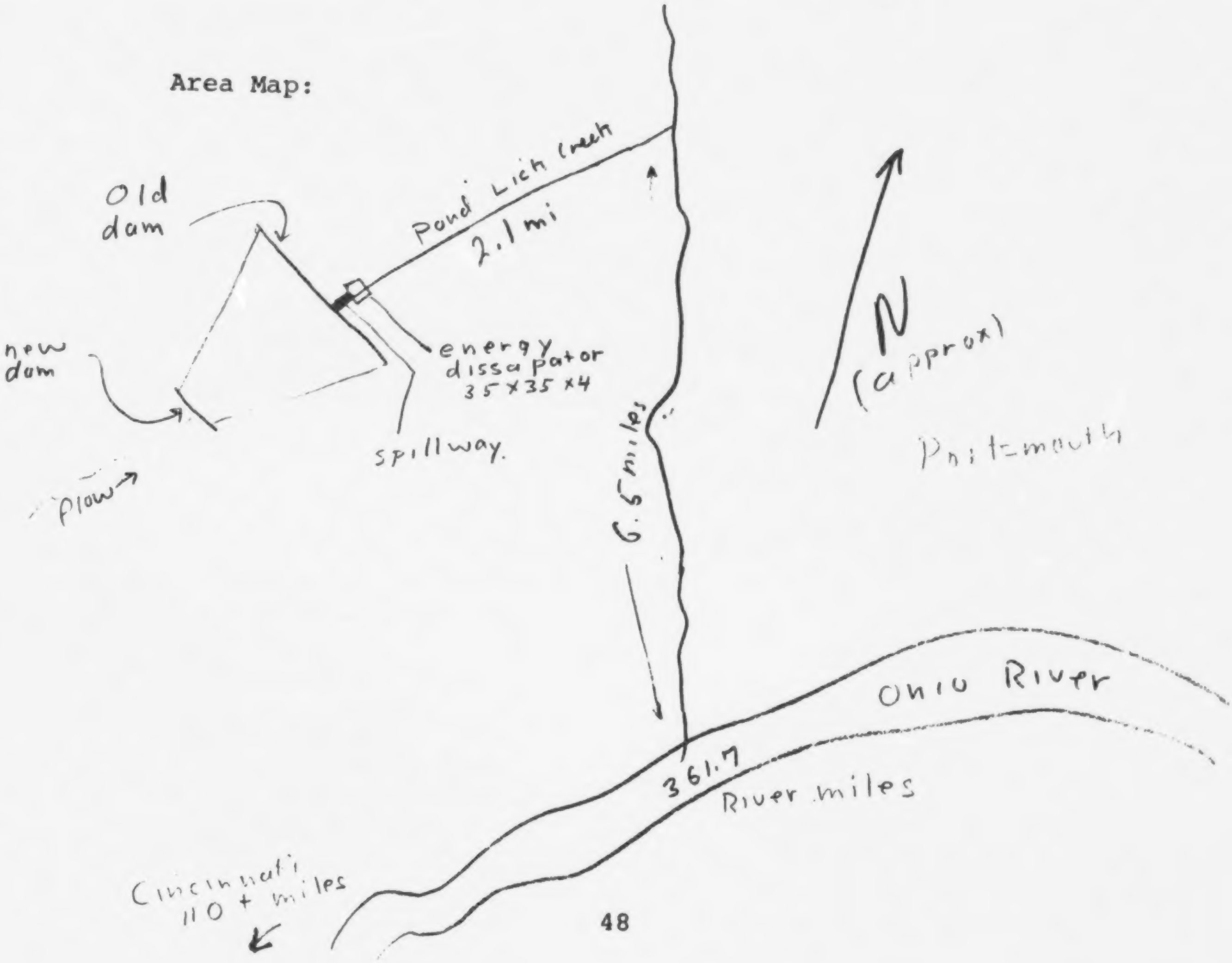
Basis of Decision: Known adsorption of endrin on A.C.
Lack of chemical treatment
Insensitive to biological treatment

III SPILL DEFINITION (Continued)

Profile of Affected Area:


complete kill
spillway
35'
Pond Lick Creek
On shale bedrock
new dam
old dam
1000'
0-0.2 mi
complete kill
0.2-0.6 mi
heavy damage
1.0 mi →
no apparent damage

Area Map:


Old dam
Pond Lick Creek
2.1 mi
new dam
energy dissapator
35 x 35 x 4
spillway
flow
6.5 miles
N
(approx)
Portsmouth
Ohio River
361.7
River miles
Cincinnati
110 + miles

IV. PROBABLE COUNTER MEASURES:

	Counter Measures	Material Supplies Manpower Reqmnts.	Technique	Estimated Time Required
Containment:	Dam lake	Met by Ohio		
	Isolate lake and let settle	Better dam and diversion		Months to 3 years or more
	Chem ppt. or carbon	Chemicals Spreaders	Settle or ppt.	Week
Treatment:	If concentration gradient drain bottom, treat remaining pool	pumps chemicals	pump and filter	Week (?)
Removal:	Filter Water	Activated carbon filter operators pump	pump lake through pipe filter	?
	Filter Water	"	Carbon in hydraulic structure	?
	Filter Water	"	Carbon in bags pulled through water.	?

V. METEOROLOGICAL AND CLIMATOLOGICAL REPORT

	Since Spill	Present	24-48 hour Forecast
Weather:	Thunderstorms Intermittent	Thunderstorm	Thundershowers
Wind (Beaufort Scale):		<.5 knots	
Rainfall			
Quantity:		Very little	
Time:		10 - 15 min	
Effect on Water Level		minimal	

VI. GEOLOGICAL REPORT

1. Location:

Quadrangle: Pond Run Quad (7-1/2 Minute USGS)

County: Scioto

City, etc. 6 - 7 Mi S.W. Portsmouth, Ohio

Drainage Basin Turkey Creek trib. to Ohio River

2. Purpose(s) of Lake and Age

Designated Legitimate Use: fishing (Flood Control?)

Lined

Unlined X (?)

3. Lake Configuration:

Surface Area 3 acres

Shape: triangle

Depth: 30± feet

Shore Line: Regular - steep banks, no swampy zone

Surrounding Topography:

Steep, parallel ridges - 45° slope

VI. GEOLOGICAL REPORT

4. Bottom Sediments (mud/water interface)

Ooze thickness ?

Permeability ?

Was bottom scraped in construction process?
?

5. Nature of bedrock
Shale - generally impervious; thickness of shale or underlying formations not known - little ground water in area.

6. Nature of Shoreline See #3 above

7. Aquifer characteristics - Shale underlying formations not known

Size ?

Depth ?

Transmissibility (rate of movement and time of travel of contaminants)

VII. SAMPLING PROGRAM (Spatial and Temporal Distribution)

Station No.______________ Date:______________ Time:__________

	Frequency	Analytical Procedure
Air/Water Interface		
Physical		
Chemical		
Biological		

	Frequency	Analytical Procedure
Vertical Profiles		
Physical		
Chemical		
Biological		

	Frequency	Analytical Procedure
Mud/Water Interface		
Physical		
Chemical		
Biological		

VII. SAMPLING PROGRAM (Continued)

	Frequency	Analytical Procedure
Shore Zone		
Physical		
Chemical		
Biological		
Current System		
Floatables		
Drift Card's		
Current Drogues		
Collect Dead Species		
Microscopic Work		
Well Water Sampling		

VIII. AERIAL RECONNAISSANCE REPORT

IX. PROPOSED ECOLOGICAL RECOVERY PROGRAM

Source reference: Water Quality Criteria, Second Edition
by McKee and Wolf; State Water Quality
Control Board, Sacramento, California

ENDRIN

1. General. Endrin is the common name for the chemical 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-endo-endo-dimethano-napthalene (364). It is insoluble in water, acetone, and benzene, and slightly soluble in alcohol (2997). Although endrin is said to have a strong residual toxicity as does its closely related compound, dieldrin (3005), endrin is reported to disappear "relatively rapidly" based upon analyses of water, mud, aquatic vegetation, and surviving fish tissues (3170). Also, another report states that endrin does not persist in soil and presents no accumulation problem, but this report advises not to contaminate areas frequented by wildlife (3171).

2. Cross References. Chlorinated Hydrocarbons, Dieldrin.

3. Effects Upon Beneficial Uses.

a. Stock and Wildlife Watering. The acute oral LD_{50} value for laboratory rats has been reported at values ranging from 7.3 to 48 mg/kg of body weight (2992, 2999, 3002, 3005, 3172, 3173). Chronic feeding of 100 mg/kg in the diet of males and 25 mg/kg for females gave significant mortality to the same degree. Endrin has been used as a broadcast spray at up to 2.5 lbs/acre to control field rodents (3005). Younger males and older females appear to be more susceptible than their counterparts (3173).

Dogs appear to be more sensitive than rats. Death occurred within six weeks at dietary levels as low as 10 mg/kg, abnormal effects at 4 mg/kg (3005). Oral LD_{50} values for male and female monkeys were 3 mg/kg of body weight, female rabbits 7-10 mg/kg, and male and female guinea pigs 36 and 16 mg/kg (3173).

Inclusion of endrin at 1 mg/kg in the diet of growing quail resulted in high mortality rates. Young pheasants failed to survive on a diet containing 5 mg/kg of endrin. However, no ill effects were noted when quail were fed winter diets containing 1 mg/kg. Hatchability of eggs and viability of chicks were adversely affected by the inclusion of endrin in the reproduction diet (3044, 3045). The inclusion of 1 mg/kg in the diet will cause a 40 percent or more decrease in the reproduction of quail. The amount of endrin that will produce at least 50 percent mortality in bobwhite quail and ringneck pheasant considering all stages of the life cycle are 5 and 14 mg/kg, respectively (2994, 2996).

The LD_{50} values of one-week old chicks is 3.5 mg/kg of body weight. Young chickens, two-months old, incurred a 10 percent mortality at 4.3 mg/kg. In chronic feeding tests with chicks up to seven weeks of age, 95 percent died at 12 mg/kg, 15 percent at 6 mg/kg (3005).

b. Fish and Aquatic Life. Fish are highly sensitive to endrin. Various figures noted in the literature are as follows:

Concentration of Endrin mg/l	*Type of Fish*	*Results*	*Reference*
0.0006	Bluegills	96-hour TL_m	3012
0.001	Guppies	Abnormal behavior in 5 hours (20°C), death in 24 hours	2992
0.0015	Golden shiners	TL_m	3005
0.003	Bass	TL_m	3005
0.003	Bluegill	TL_m	3005
0.003	Goldfish	TL_m	3005
0.005	Carp fingerlings	48-hour TL_m (28°C)	3012
0.005	Carp fingerlings	24-hour TL_m	3175
0.006	Carp fingerlings	48-hour TL_m (18°C)	3012
0.051	Salmon	96-hour TL_m (20°C)	3174
0.1	Fish	Death	3102
0.14	Carp fingerlings	48-hour TL_m (8°C)	3012
0.61	5-day carp fry	24-hour TL_m (20°C)	3175
4.2	4-day cary fry	24-hour TL_m (20°C)	3175
10.7	2-day carp larvae	24-hour TL_m (20°C)	3175
20	Carp eggs	24-hour TL_m (20°C)	3175

Field applications to rice paddies of one or two lbs/acre remained toxic to fish for over one month (3175). Although laboratory studies indicated a TL_m value for endrin of between 1.0 and 1.5 µg/l, a dose of 1.0 µg/l to a pond gave no results. A second dose of 1.0 µg/l was administered, but was still without effect. Rapidly lowering temperatures were thought to be inhibiting the lethal effects (3176, 3178). Endrin, used in sugar cane fields to combat borers, has washed into streams during heavy rains, causing fish kills (3177).

The 96-hour TL_m values of endrin to fathead minnows in hard and soft water at 25°C were, respectively, 1.3 and 1.0 µg/l. Tests with bluegills, goldfish, and guppies in soft water at 25°C gave values of 0.60, 1.9, and 1.5 µg/l respectively (3000).

In a series of screening tests of a large number of compounds, rainbow trout, bluegill sunfish, and the sea lamprey all died within 14 hours at 12°C when exposed to a 5 mg/l concentration of an 18½ percent emulsion of endrin (2976). The estimated concentration of endrin required to immobilize *Daphnia magna* in 50 hours at 20°C is 352 µg/l (3255).

Source reference: Report of the Committee on Water Quality Criteria, Federal Water Pollution Control Administration, U. S. Department of the Interior, April, 1968.

TABLE III–5A. Pesticides [*]

INSECTICIDES

[48-hour TL_m values from static bioassay, in micrograms per liter. Exceptions are noted.]

Pesticide	Stream invertebrate [1]		Cladocerans [2]		Fish [3]		Gammarus lacustris,[4]
	Species	TL_m	Species	TL_m	Species	TL_m	TL_m
Abate	Pteronarcys californica.	100	------	------	Brook trout	1,500	640
Aldrin [5]	P. californica	8	Daphnia pulex.	28	Rainbow trout.	3	12,000
Allethrin	P. californica	28	D. pulex	21	do	19	20
Azodrin	------	------	------	------	do	7,000	------
Aramite	------	------	D. magna	345	Bluegill	35	100
Baygon [5]	P. californica	110	------	------	Fathead	25	50
Baytex [5]	P. californica	130	Simocephalus serrulatus.	3.1	Brown t.	80	70
Benzene hexachloride (lindane).	P. californica	8	D. pulex	460	Rainbow t.	18	88
Bidrin	P. californica	1,900	D. pulex	600	do	8,000	790
Carbaryl (sevin)	P. californica	1.3	D. pulex	6.4	Brown t.	1,500	22
Carbophenothion (trithion).	------	------	D. magna	0.009	Bluegill	225	28
Chlordane [5]	P. californica	55	S. serrulatus	20	Rainbow t.	10	80
Chlorobenzilate	------	------	S. serrulatus	550	do	710	------
Chlorthion	------	------	D. magna	4.5	------	------	------
Coumaphos	------	------	D. magna	1	------	------	0.14
Cryolite	------	------	D. pulex	5,000	Rainbow t.	47,000	------
Cyclethrin	------	------	D. magna	55	------	------	------
DDD (TDE) [5]	P. californica	1,100	D. pulex	3.2	Rainbow t.	9	1.8
DDT [5]	P. californica	19	D. pulex	0.36	Bass	2.1	2.1
Delnav (dioxathion)	------	------	------	------	Bluegill	14	690
Delmeton (systex)	------	------	------	14	do	81	------
Diazinon [5]	P. californica	60	D. pulex	0.9	do	30	500
Dibrom (naled)	P. californica	16	D. pulex	3.5	Brook t.	78	160
Dieldrin [5]	P. californica	1.3	D. pulex	240	Bluegill	3.4	1,000
Dilan	------	------	D. magna	21	do	16	600
Dimethoate (cygon).	P. californica	140	D. magna	2,500	do	9,600	400
Dimethrin	------	------	------	------	Rainbow t.	700	------
Dichlorvos [5] (DDVP)	P. californica	10	D. pulex	0.07	Bluegill	700	1
Disulfoten (di-syston)	P. californica	18	------	------	do	40	70
Dursban	Peteronareella badia	1.8	------	------	Rainbow t.	20	0.4
Endosulfan (thiodan)	P. californica	5.6	D. magna	240	do	1.2	64
Endrin [5]	P. californica	0.8	D. pulex	20	Bluegill	0.2	4.7
EPH	------	------	D. magna	0.1	do	17	36
Ethion	P. californica	14	D. magna	0.01	do	230	3.2
Ethyl guthion [5]	------	------	D. pulex	------	Rainbow t.	------	------
Fenthion	P. californica	39	D. pulex	4	------	------	------
Guthion [5]	P. californica	8	D. magna	0.2	Rainbow t.	10	0.3
Heptachlor [5]	P. badia	4	D. pulex	42	do	9	100
Kelthane (dicofel)	P. californica	3,000	D. magna	390	do	100	------
Kepone	------	------	------	------	do	37.5	------
Malathion [5]	P. badia	6	D. pulex	1.8	Brook t.	19.5	1.8
Methoxychlor [5]	P. californica	8	D. pulex	0.8	Rainbow t.	7.2	1.3
Methyl parathion [5]	------	------	D. magna	4.8	Bluegill	8,000	------
Morestan	P. californica	40	------	------	do	96	------
Ovex	P. californica	1,500	------	------	do	700	------
Paradichlorobenzene	------	------	------	------	Rainbow t.	880	------
Parathion [5]	P. californica	11	D. pulex	0.4	Bluegill	47	6
Perthane	------	------	D. magna	9.4	Rainbow t.	7	------
Phosdrin [5]	P. californica	9	D. pulex	0.16	do	17	310
Phosphamidon	P. californica	460	D. magna	4	do	8,000	3.8
Pyrethrins	P. californica	64	D. pulex	25	do	54	18
Rotenone	P. californica	900	D. pulex	10	Bluegill	22	350
Strobane [5]	P. californica	7	------	------	Rainbow t.	2.5	------
Tetradifon (tedion)	------	------	------	------	Bluegill	1,100	140
TEPP [5]	------	------	------	------	Fathead	390	52
Thanite	------	------	D. magna	450	------	------	------
Thimet	------	------	------	------	Bluegill	5.5	70
Toxaphene [5]	P. californica	7	D. pulex	15	Rainbow t.	2.8	70
Trichlorofon (dipterex).[5]	P. badia	22	D. magna	8.1	do	160	60
Zectran	P. californica	16	D. pulex	10	do	8,000	76

[*] See notes following Table III-5B.

STRICTLY CONFIDENTIAL

Situation Report No. 3

RETA No. 862-1

TIME PERIOD:

From: 12:00 noon, June 14, 1971

To: 6:00 p.m. June 17, 1971

TO:

Dr. C. H. Thompson, Project Officer
Environmental Protection Agency
1921 Jefferson Davis Highway
Arlington, Virginia 22202

FROM:

Dr. George M. Barsom, Project Manager
Ryckman, Edgerley, Tomlinson and Associates, Inc.
225 S. Meramec
St. Louis, Missouri 63105

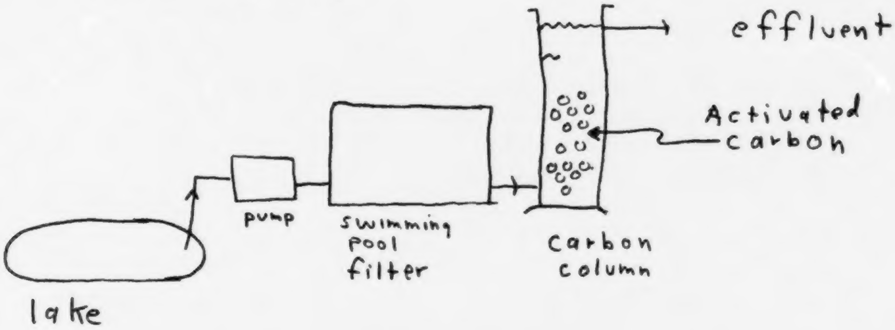
RETA 862-1

DATE: June 18, 1971

I. INFORMATION FROM THE FIELD

Major effort appears to center on the construction of a pilot plant to run at about 10 GPM.

1. The pilot plant is built around a commercial swimming pool filter being used as a rapid sand filter to remove some organic material and silt from the water. The output of the pool filter is fed to a vertical carbon column 18" diameter and 7½ ft. tall. This system will be used to establish the required contact time and perhaps carbon capacity.



2. The inlet dam structure is working well. Rain estimated ½" in a 3½ - 4 hour period - 6/15 was captured and pumped around the lake by one of two pumps available. The quantity of water pumped was not known but was thought to be about 3000 GPM.

3. Ohio State University is providing a gas chromatograph on the scene. Installation should be complete by June 17, 1971. This will permit more rapid evaluation of the pilot plant.

4. There is a possibility of a 50,000 GPD portable plant being brought to the site either as a large scale pilot plant or to control the level of the lake if very heavy rain would raise the level.

5. Some bottom samples have been taken and are being analyzed in Cincinnati.

II. Ecological Damage and Recovery Survey

A program to assess the ecology of the damaged area needs to be formulated and implemented. Benthic and periphyton samples in the lake, inlet stream and discharge streams need to be collected and analyzed. Pond Lick Creek has suffered visible damage 1/2 mile below the spillway as was noted in situation report #1. The ecological study is needed to make sure no further damage occurs in connection with treating the lake or eventual discharges from the spillway. A series of sample stations, outlined on the schematic map attached, need to be studied. Station 1 would be upstream of the new dam area and thus serve as a control. Fish and invertebrates from this area should be analyzed for background endrin levels. Benthetic and periphyton samples are needed also. Stations 4-6 on Pond Lick Creek would show damage done by the endrin before it was controlled and also be monitor points downstream during the treatment process. Stations 7 and 8 in Turkey Creek should also be monitored but do not show lethal damage. They may show a concentration of pesticide in the aquatic population and are thus important.

Wells in the area have been located from state records and (see attached maps) wells along Turkey Creek should be tested now and monthly to verify that ground water contamination has not occurred.

Stations 2 and 3 in the lake will require vertical profile sampling as well as bottom samples.

Water samples should note pH, D.O. and endrin each week and daily measurements of endrin will be needed below the discharge point if the treated water is released to the stream. In any case, fish should be put in the product water from the treatment system each 1/2 to 1 hour as a check of the effectiveness of treatment stream samples. Ecological and biological samples will probably be needed every 4 - 6 weeks to monitor the recovery of the stream system.

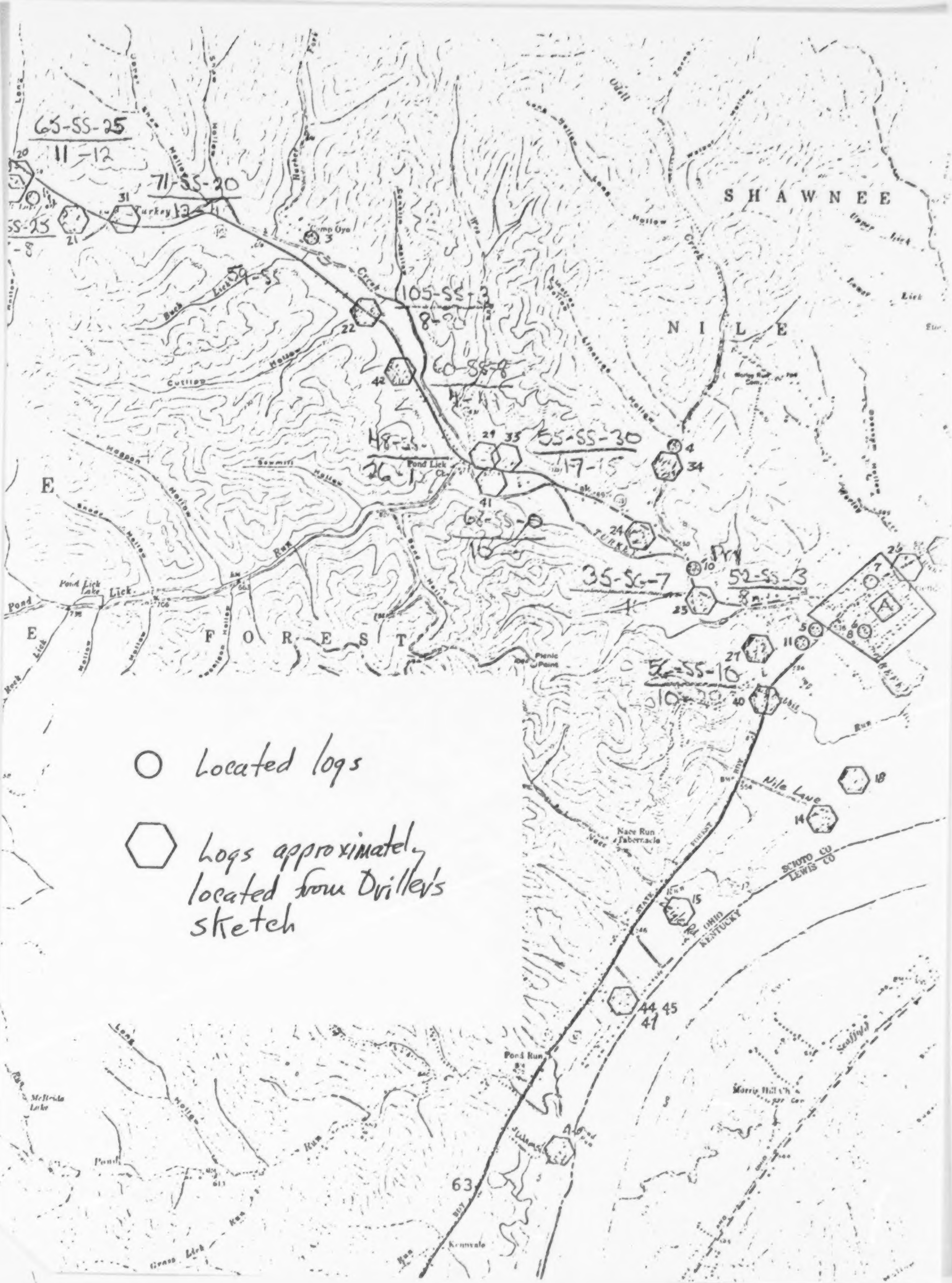
III. Recommendations for Laboratory Work on Countermeasures

We are not aware of any laboratory work that has been done on determining which one of several types of activated carbon will give the best removal of endrin from the lake water. Screening a number of samples in jar tests under standard laboratory conditions is highly desirable before a pilot study is run. This will allow the pilot study to determine the detention time and pretreatment needed for the most efficient type carbon. Without such a study the pilot plant and full scale process as well may be set up using a carbon less efficient and therefore more expensive than necessary. RETA feels strongly that laboratory testing is necessary and should include GC and bioassay studies to show removal of endrin.

IV. Countermeasures Available

To date, several countermeasures have been proposed. Some are more attractive than others economically and in probable effectiveness. However, without the previously mentioned laboratory studies it is impossible to determine with certainty what is the best alternative. The decision as to what alternative will be used must be made in the field by those with first-hand information. During this time, the RETA office facilities became a research and supply information center.

The listing below summarizes the countermeasures. Each is then shown in more detail on a separate page.


65-SS-25
11-12
71-SS-20
SS-25
105-SS-3
60-SS-8
48-SS-
26-1
55-SS-30
17-15
35-SS-7
52-SS-3
56-SS-10
Dry
SHAWNEE
NILE
FOREST
E
E
Turkey
Camp Oyo
Pond Lick
Pond Lick Lake
Picnic Point
Nace Run Tabernacle
Nile Lane
Pond Run
Morris Hill
SCIOTO CO
LEWIS CO
OHIO
KENTUCKY
Kennvale
63
A
20
21
31
3
22
42
29
33
41
4
34
24
10
25
26
7
6
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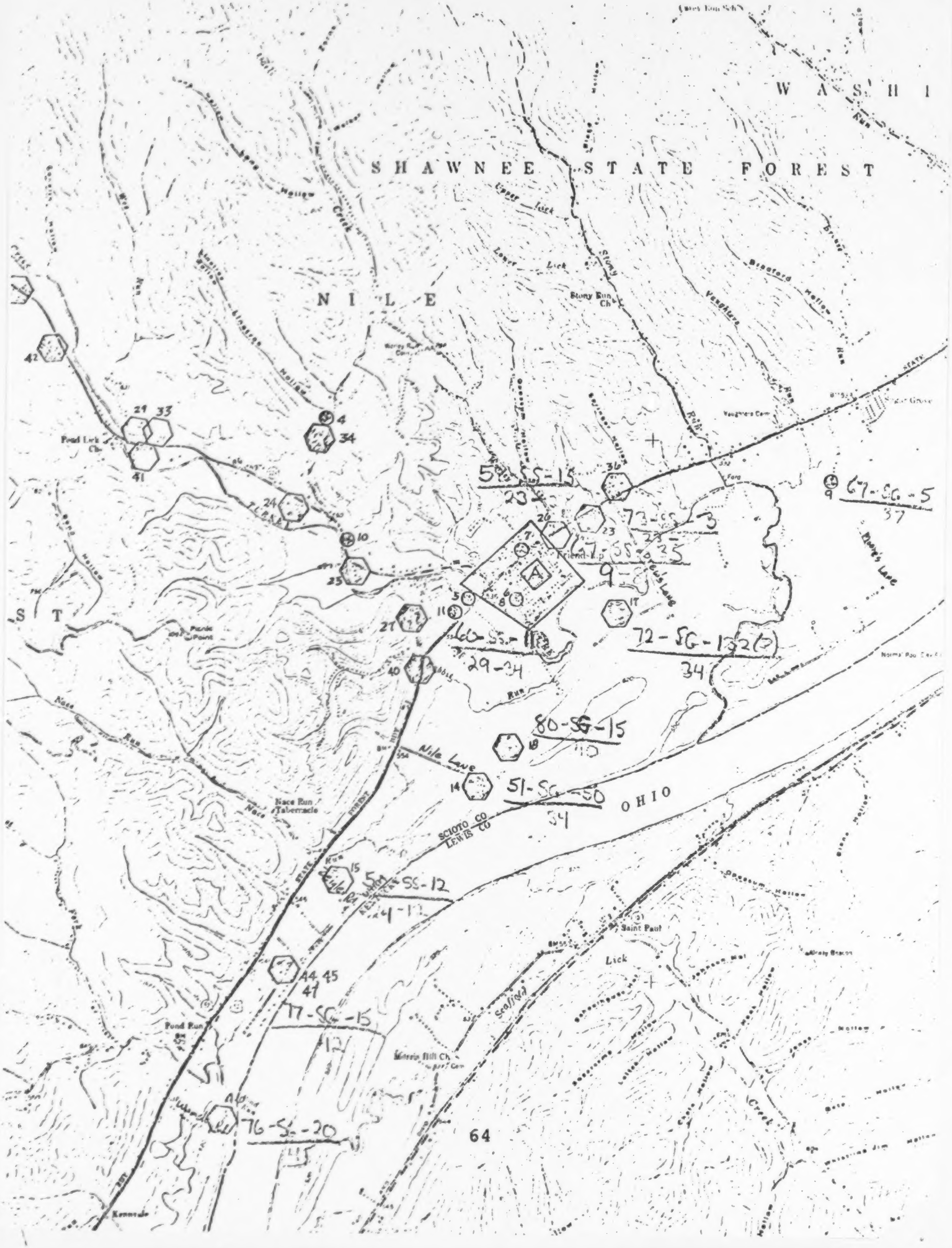
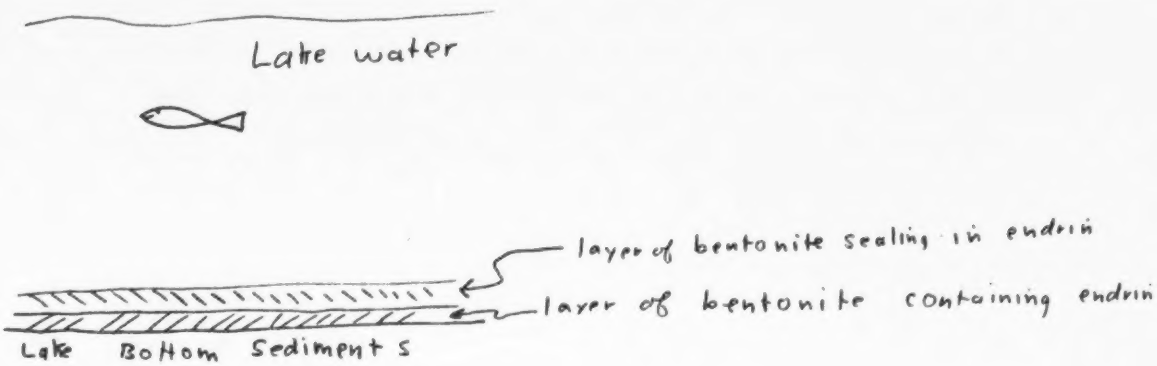
5
11
27
40
18
14
15
44 45
47
46
Located logs
Logs approximately located from Driller's sketch


WASHI
SHAWNEE STATE FOREST
Upper Lick
Lower Lick
Stony
Vaughters
Brushy
Beauford Hollow
Creek
NILE
Stony Run Ch.
Pond Lick Ch.
Vaughters Cem.
Sugar Grove
Ford
Friendship
Drew's Lane
Dever's Lane
Nile Lane
Nace Run
Nace Run Tabernacle
Pond Run
Picnic Point
ST
OHIO
SCIOTO CO
LEWIS CO
Normal Pool
Saint Paul
Lick
Scaffold
Morris Hill Ch.
Kennedy
A
42
29
33
41
4
34
24
10
25
27
40
5
11
7
6
8
26
23
36
17
18
14
15
9
44 45
47
46
59-SG-15
23
73-SG-3
23
67-SG-35
9
67-SG-5
37
60-SG-11
29-34
72-SG-132(?)
34
80-SG-15
10
51-SG-50
34
50-SG-12
41-12
77-SG-15
12
76-SG-20

1. Treat lake with bentonite slurry. Let settle.
2. Treat lake with fly ash and let settle.
3. Spread activated carbon onto the surface of the lake and let it settle.
4. Allow lake to recover itself. Monitor and bioassay extensively to gain knowledge useful in a larger spill.
5. Spray irrigate the endrin water onto surrounding land.
6. Load contents of lake into barges and take to sea.
7. Build an activated carbon filter and pass the lake through it.

COUNTERMEASURE	REFERENCE
1. Spread a slurry of bentonite on the lake, allow to settle and spread a second layer a week later to seal the endrin to the bottom.	Settling characteristics. R. L. Folk, Petrology of Sedimentary Rocks, University of Texas, 1965

Flow Diagram


Lake water
layer of bentonite sealing in endrin
layer of bentonite containing endrin
Lake Bottom Sediments

Materials

Boat to apply bentonite slurry

Slurry making equipment - pump and mixer

Approximately 1 ton bentonite ($80 - $100)

1 ton will give 2 100 mg/l applications if the lake volume really is 15 million gallons.

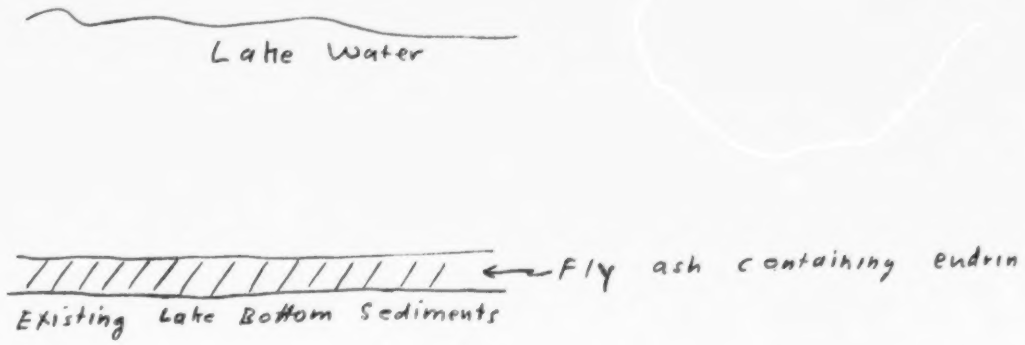
Readily available.

Procedure and Technique

Bentonite absorbs well, settles slowly, so it would scrub the whole lake and is cheap. The second layer would form a seal preventing desorption. Jar tests could quickly determine the dose. The size could be chosen to give 18 - 48 hours contact time before the clay is all on the bottom. This is an inexpensive operation, both from materials and labor viewpoint and seals the endrin into a favorable area geologically, preventing ground water contamination.

COUNTERMEASURE	REFERENCE
2. Spread fly ash on the surface of the lake. Let it settle, adsorbing endrin on the surface on the way down.	Fly Ash. J. D. Eye Research, University of Cincinnati

Flow Diagram


Lake Water
Fly ash containing endrin
Existing Lake Bottom Sediments

Materials

Fly ash - amount determined by jar tests. Should be available for hauling costs from almost any coal-fired power plant.

Procedure and Technique

Spread fly ash as a powder on the surface of the lake and let it settle. A second application may be useful to seal the endrin in and prevent desorption into the bottom water of the lake.

COUNTERMEASURE	REFERENCE
3. Spread powdered activated carbon on the lake and let settle.	Suggested by early action of State of Ohio.

Flow Diagram

Materials

Powdered activated carbon - equivalent to Aqua-Nu-Char. App. 9¢/lb. One firm offered enough carbon free to treat the lake. This was an estimated 200 lbs. of material.

Procedure and Technique

Spread the activated carbon and let it settle, picking up endrin as it falls. This requires a fine powdered carbon, not a granular material.

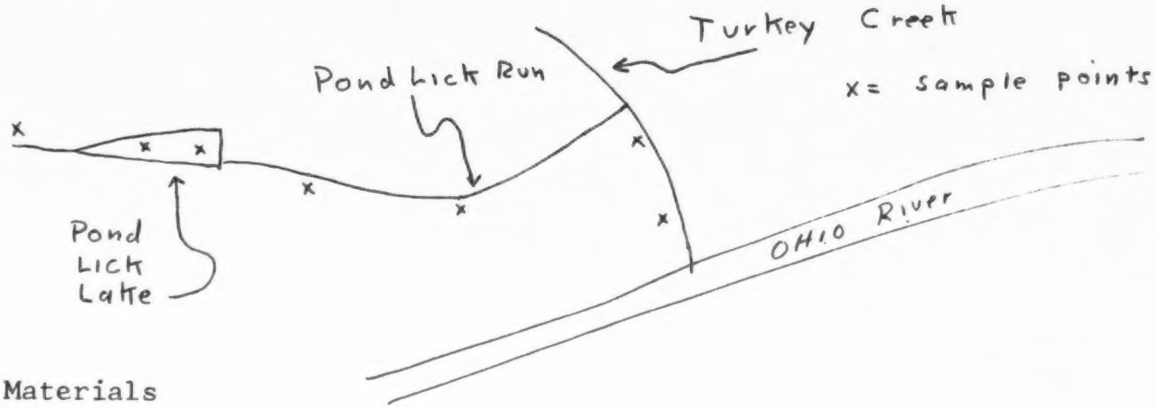
COUNTERMEASURE

REFERENCE

4. Let the lake recover itself.

Dr. R. E. Hanson,
Shell Chemical Co.
Agriculture Products Div.
San Ramon, California
(telephone 6/15/71 to
D. Clement, RETA,
St. Louis)

Flow Diagram



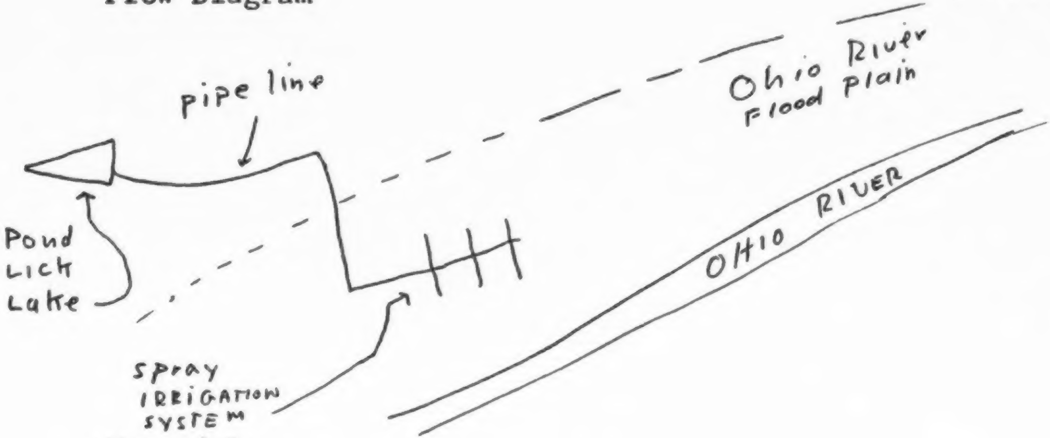
Materials

Procedure and Technique

Monitor the recovery in terms of endrin in Pond Lick Creek and Turkey Creek. Level of endrin involved is not thought to present a hazard to man or livestock now. The time required to allow fish to live in the lake again could be determined. Caged bluegills or continuous bioassay with stream side tanks are possible. This would permit gathering information useful if a much larger lake were poisoned when it would be impractical to treat it.

COUNTERMEASURE	REFERENCE
5. Spray irrigate onto surrounding land.	Telephone conversation 6/16 SJR/GMB - SJR/DPC Absorptive capacity of soil. Sc.D. Research, J. D. Eye, University of Cincinnati, 1966.

Flow Diagram



Materials

Pipeline to Ohio River flood plain or truck transport to the flood plain. Irrigation equipment to apply to soil.

Procedure and Technique

Soil is a good adsorbant of endrin and probably would filter the endrin out of the water. The golf course on the Ohio river flood plain may be a possible area to irrigate but the possibility of contaminating ground water aquifers shown on the geologic section map in report #2 is greatly increased. The cost of pipeline or truck to the irrigation area is probably too great to make this possible. Head loss on pipe system makes a gravity flow distribution doubtful.

COUNTERMEASURE REFERENCE

6. Load contents of lake on to barges and take to sea for dumping.

Flow Diagram

Materials

Probable barging costs - $1.00 - 1.25 mil/ton-mile, would need about 18 standard 840,000 gallon barges. This is expensive and the barges couldn't go into the Gulf to dump. Would also require pipeline or trucks to load barge.

Costs per telephone call to Ralph Clark 6/16/71

Procedure and Technique

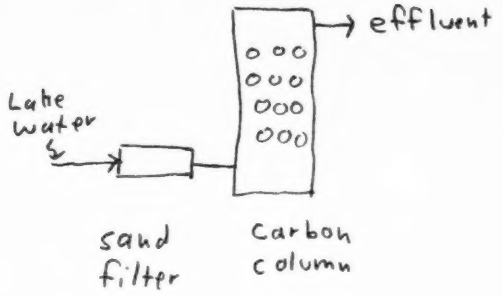
Transport by pipe or truck to barge. Take to mouth of Mississippi River and discharge slowly if weather did not permit risking river barges in open sea.

COUNTERMEASURE | REFERENCE

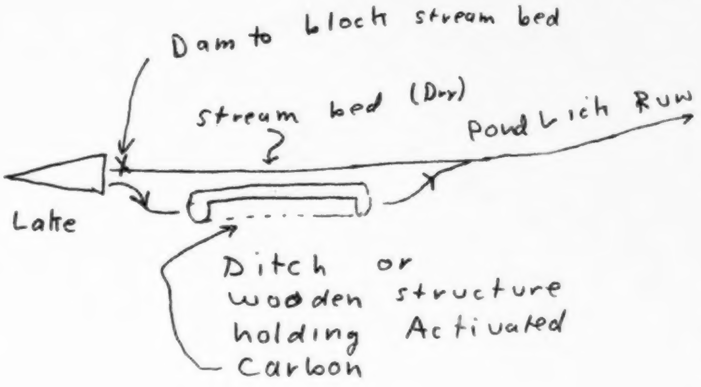
7. Activated carbon filter systems.

JAWWA
Vol. 57, p. 185,
February, 1965
Effectiveness of A.C.

Flow Diagram


effluent
Lake water
sand filter
Carbon column

2.


Dam to block stream bed
Stream bed (Dry)
Pond Lick Run
Lake
Ditch or wooden structure holding Activated Carbon

3

Materials

1. Activated carbon approximately 2,500 ft.^{3}
   20 - 40 #/ft^3 Cost \$12,000 - \$20,000
2. Confinement structure
   pressure vessel - app. \$12,000
3. Ditch or wooden structure
   to hold carbon - app. \$5,000
4. Regeneration, disposal of carbon

Procedure and Technique

1. Pressure filter assembly built on site.
2. A. C. in a ditch lined with polyethyline.
3. A. C. in a wooden structure on surface of ground.

FAB, carbon manufacturers - telephon conferences

Calculations based on 1000 GPM, 15 minutes detention time, indicate need for 2500 ft^3 carbon. Carbon weighs 30 - 40#/ft^3

Recycle to lake possible and desirable until process well under control

Field discussion

Regenerate carbon in furnace to destroy endrin - by contract

APPENDIX C

GEOLOGICAL REPORT

The Department of Water, Division of Natural Resources, provided RETA with well logs and basic information which permitted the completion by Monday, June 14, 1971, of an analysis of the danger to ground water in the area. This information showed that a 40 foot thick layer of impermeable shale separated the lake from ground water, and that ground water in the area was very poor. Many of the drilled wells are dry or provide a flow of less than five gallons per minute. RETA concluded that it was unlikely that any ground water contamination would occur unless the entire lake were to drain to the Ohio River flood plain at one time. The Ohio River flood plains do contain aquifers which potentially are very good sources of water with well yields of 1000 GPM expected. They should not be exposed to the poison by activities such as landfilling bottom material scraped from the lake. The geological report with Figures 12 and 13 follows:

I. Groundwater

There is little chance of seepage of Pond Lick Lake water into groundwater. The bedrock under the lake is largely impermeable shale with some interbedded sands. Most of the sands are poorly sorted and not good aquifers. Furthermore, they are thin and isolated from each other by interbedded shales. The shales effectively isolate the sand layers so little water can collect or flow through the sand. Maximum yields for these sands might be app. 5 gpm.

The Berea sandstone, which is probably 50 feet below lake, consists of interbedded sandstone and shale with sands up to two feet thick. The Berea may yield some water, but because of interbedded shales, it is not a good aquifer.

The first good aquifers below the lake are Devonian limestone and dolomites of Middle Devonian age which are 600 feet below the lake, and probably bear brackish water.

The only other aquifer in the area is the alluvial deposit in the Scioto and Ohio Valleys. The Pond is isolated from these alluvial materials by the above described shales and contamination would not be a problem unless the material in the lake overflowed and ran down Turkey Creek to

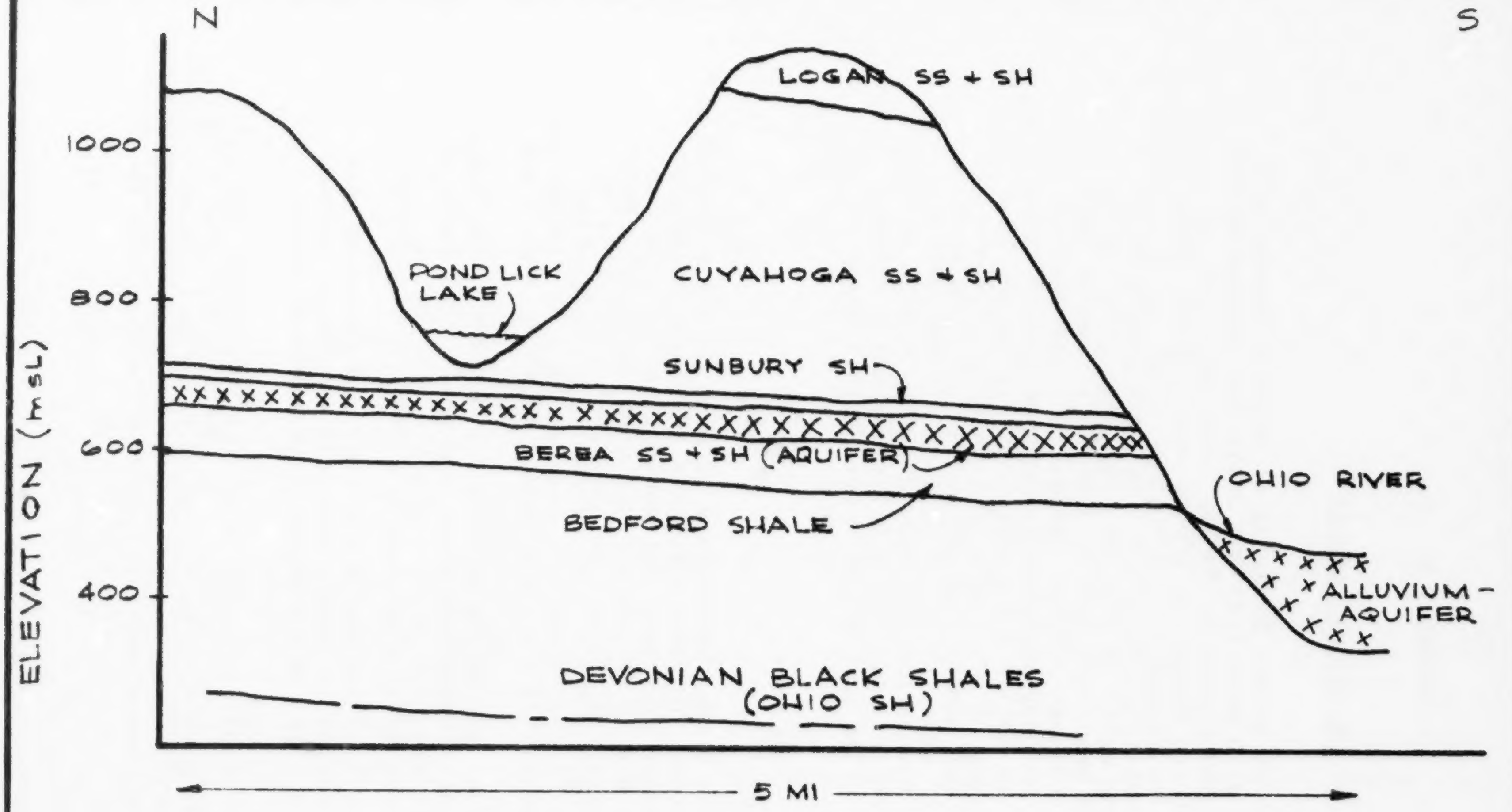

N
S
ELEVATION (m SL)
1000
800
600
400
LOGAN SS + SH
POND LICK LAKE
CUYAHOGA SS + SH
SUNBURY SH
BEREA SS + SH (AQUIFER)
BEDFORD SHALE
OHIO RIVER
ALLUVIUM - AQUIFER
DEVONIAN BLACK SHALES (OHIO SH)
5 MI

FIGURE 12

NORTH-SOUTH CROSS SECTION
POND LICK OHIO
REGION

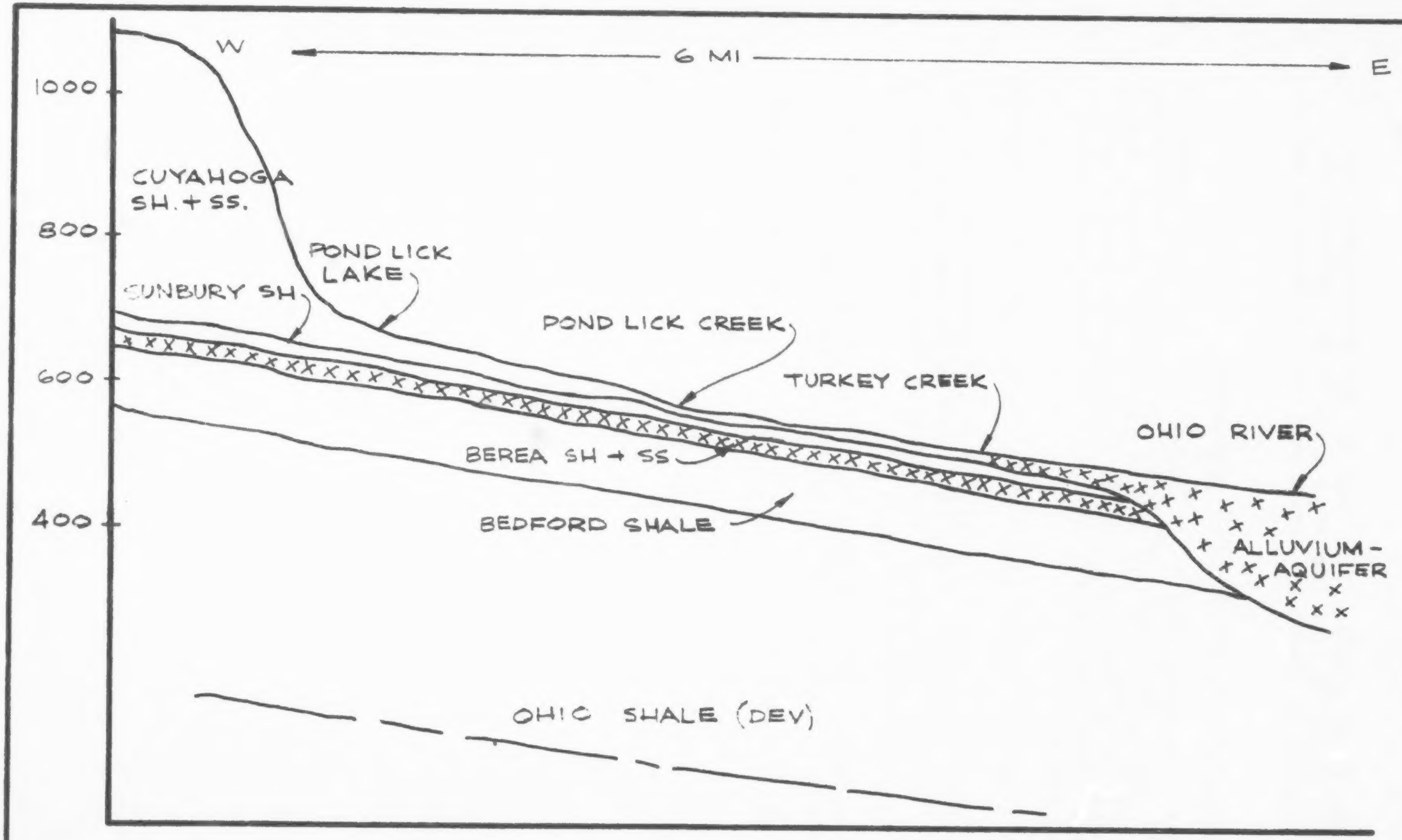

W
6 MI
E
1000
800
600
400
CUYAHOGA SH. + SS.
POND LICK LAKE
SUNBURY SH
POND LICK CREEK
TURKEY CREEK
OHIO RIVER
BEREA SH + SS
BEDFORD SHALE
ALLUVIUM - AQUIFER
OHIO SHALE (DEV)

FIGURE 13

EAST-WEST SCHEMATIC
CROSS SECTION
POND LICK OHIO
REGION

the Ohio Flood plain. The lake is 200 feet above the alluvial material and isolated from it by impermeable shale layers as shown by cross sections, Figures 12 and 13.

II. Geologic Column at Pond Lick Lake

Surface - Cuyahoga Shale and Sandstone; total thickness of 300 feet, 20/30 feet of this layer is below lake level, gray shale, sandstone and siltstone, poorly sorted, not a source of groundwater. Lower Cuyahoga is Buena Vista member. Sandstones are from 1" to 16" thick with interbedded shale.

Sunbury Shale: 20-30 feet, Dark Shale. Not water bearing.

Berea Sandstone: 20-60 feet, gray sandstones up to 2 feet thick with interbedded shales. May carry some water locally. Sand is generally not well sorted and is therefore not a good aquifer.

Bedford Shale: 50-110 feet, gray interbedded sandstone and shale. Sands are thin. Does not bear water.

Ohio Shale: 400 feet, black shale. Does not bear water.

APPENDIX D

ALTERNATE STRATEGIES CONSIDERED

The primary consideration of the field team was to find a satisfactory method to eliminate the poison from the lake rapidly since the upper diverting dam was only temporary and could not be relied upon for long-term protection.

The costs of different treatment methods were roughly estimated, as was the time required to implement the plan. These strategies were forwarded to the field where they were discussed with other ideas formulated on site and by Dr. Thompson.

Also sent to the field was information on performance standards required in terms of Endrin toxicity tolerances. This information is shown in this appendix.

Initial failure of the activated carbon spread on the lake to remove Endrin led to the feeling that a pilot plant assembly was necessary prior to any further large scale use of carbon.

Public concern and the need to do "something" to show removal of the poison was a factor involved in the decision to use a removal technique rather than a less expensive in-place treatment of the Endrin.

This section of the report discusses seven alternate treatment methods in some detail. The methods are:

1. Treat lake with bentonite slurry. Let settle.
2. Treat lake with fly ash and let settle.
3. Spread powdered activated carbon onto the surface of the lake and let it settle.
4. Allow lake to recover itself. Monitor and bioassay extensively to gain knowledge useful in a larger spill.
5. Spray irrigate the Endrin water onto surrounding land.
6. Load contents of lake into barges and take to sea.
7. Build an activated carbon filter and pass the lake through it.

COUNTERMEASURE	REFERENCE
1. Spread a slurry of bentonite on the lake, allow to settle and spread a second layer a week later to seal the Endrin to the bottom.	Settling characteristics. R. L. Folk, *Petrology of Sedimentary Rocks*, University of Texas, 1965.

Materials

Boat to apply bentonite slurry.
Slurry making equipment - pump and mixer

Approximately 1 ton bentonite ($80 - $100)
1 ton will give approximately 100 mg/l applications if the lake volume really is 15 million gallons.
Readily available.

Procedure and Technique

Bentonite absorbs well, settles slowly, so it would scrub the whole lake and is cheap. The second layer would form a seal preventing desorption. Jar tests could quickly determine the dose. The size could be chosen to give 18 - 48 hours contact time before the clay is all on the bottom. This is an inexpensive operation, both from materials and labor viewpoint and seals the Endrin into a favorable area geologically, preventing ground water contamination.

COUNTERMEASURE	REFERENCE
2. Spread fly ash on the surface of the lake. Let it settle, adsorbing Endrin on the surface on the way down.	Fly Ash. J. D. Eye Research, University of Cincinnati.

Materials

Fly ash - amount determined by jar tests. Should be available for hauling costs from almost any coal-fired power plant.

Procedure and Technique

Spread fly ash as a powder on the surface of the lake and let it settle. A second application may be useful to seal the Endrin in and prevent desorption into the bottom water of the lake.

COUNTERMEASURE	REFERENCE
3. Spread powdered activated carbon on the lake and let it settle.	Suggested by early action of State of Ohio.

Materials

Powdered activated carbon - equivalent to Aqua-Nu-Char. App. 9¢/lb. One firm offered enough carbon free to treat the lake. This was an estimated 200 lbs. of material.

Procedure and Technique

Spread the activated carbon and let it settle, picking up Endrin as it falls. This requires a fine powdered carbon, not a granular material.

COUNTERMEASURE	REFERENCE
4. Let the lake recover itself.	Dr. R. E. Hanson, Shell Chemical Co. Agriculture Products Div. San Ramon, California (telephone 6/15/71 to D. Clement, RETA, St. Louis).

Materials

Procedure and Technique

Monitor the recovery in terms of Endrin in Pond Lick Creek and Turkey Creek. Level of Endrin involved is not thought to present a hazard to man or livestock now. The time required to allow fish to live in the lake again could be determined. Caged bluegills or continuous bioassay with stream side tanks are possible. This would permit gathering information useful if a much larger lake were poisoned when it would be impractical to treat it.

COUNTERMEASURE	REFERENCE
5. Spray irrigate onto surrounding land.	Telephone conversation 6/16 SJR/GMB - SJR/DPC Absorptive capacity of soil. Sc.D. Research, J. D. Eye, University of Cincinnati, 1966.

Materials

Pipeline to Ohio River flood plain or truck transport to the flood plain. Irrigation equipment to apply to soil.

Procedure and Technique

Soil is a good adsorbant of Endrin and probably would filter the Endrin out of the water. The golf course on the Ohio River flood plain may be a possible area to irrigate but the possibility of contaminating ground water aquifers shown on the geologic section map in Appendix C is greatly increased. The cost of pipeline or truck to the irrigation area is probably too great to make this possible. Head loss on pipe system makes a gravity flow distribution doubtful.

COUNTERMEASURE	REFERENCE
6. Load contents of lake on to barges and take to sea for dumping.	

Materials

Probable barging costs - 1.00 - 1.25 mil/ton-mile, would need about 18 standard 840,000 gallon barges. This is expensive and the barges couldn't go into the Gulf to dump. Would also require pipeline or trucks to load barge.

Costs per telephone call to Ralph Clark 6/16/71.

Procedure and Technique

Transport by pipe or truck to barge. Take to mouth of Mississippi River and discharge slowly if weather did not permit risking river barges in open sea.

COUNTERMEASURE	REFERENCE
7. Activated carbon filter systems.	JAWWA Vol. 57, p. 185, February, 1965 Effectiveness of A.C.
Materials 1. Activated carbon approximately 2,500 ft.^{3} 20 - 40 #/ft^3 Cost \$12,000 - \$20,000 2. Confinement structure pressure vessel - app. \$12,000 3. Ditch or wooden structure to hold carbon - app. \$5,000 4. Regeneration, disposal of carbon	
Procedure and Technique 1. Pressure filter assembly built on site. 2. A. C. in a ditch lined with polyethylene. 3. A. C. in a wooden structure on surface of ground.	FAB, carbon manufacturers - telephone conferences.
Calculations based on 1000 GPM, 15 minutes detention time, indicate need for 2500 ft^3 carbon. Carbon weights 30 - 40#/ft^3.	
Recycle to lake possible and desirable. Field discussion until process well under control.	Field discussion.
Regenerate carbon in furnace to destroy Endrin - by contract.	

APPENDIX E

TREATMENT SYSTEM

This section of the report details the decision to build a pilot plant to measure the effectiveness of a carbon filter and illustrates the means by which the successful operation of the pilot plant led directly to the design, construction, and operation of the prototype plant built to treat Pond Lick Lake.

Pilot Plant

The combined field team of State, Federal and RETA consultants felt a definite need to evaluate activated carbon in a pilot scale operation after the failure to function of the first carbon applied to the lake.

Published literature (JAWWA 57:181-199, 1965) showed that activated carbon was effective in removing Endrin at a loading rate of 0.5 GPM/cubic foot of carbon. The pilot plant was built with this flow as the loading criteria.

Tuesday afternoon in a meeting of all present field personnel, Dr. Thompson suggested and Mr. Nye approved design and construction of a pilot plant. RETA engineers designed the plant from a rough sketch by Dr. Thompson.

The decision was made about 6 p.m. By 9 p.m. construction had started, a pressure filter from a swimming pool had been located and arrangements made to ship it to the site the next day. Electricity was ordered and installed about daybreak Wednesday. Welders worked through the night Tuesday to fabricate a column to hold the carbon bed. Construction was completed and the plant put in operation Wednesday afternoon. The pilot plant under construction is shown in Figures 14, 15a, and 15b.

The pilot plant was designed to answer several questions in a planned operating period of 24-48 hours:

1. Determine the Endrin adsorption capacity of activated carbon. This figure would give an estimate of the carbon needed to treat the entire lake if it were to be filtered.
2. Determine the residual level of Endrin and thus the removal efficiency of the activated carbon process. This would also indicate the ability of the system to meet effluent standards for Endrin in water.
3. Confirm suitability of the chosen loading rate and study effects of varying the rate.

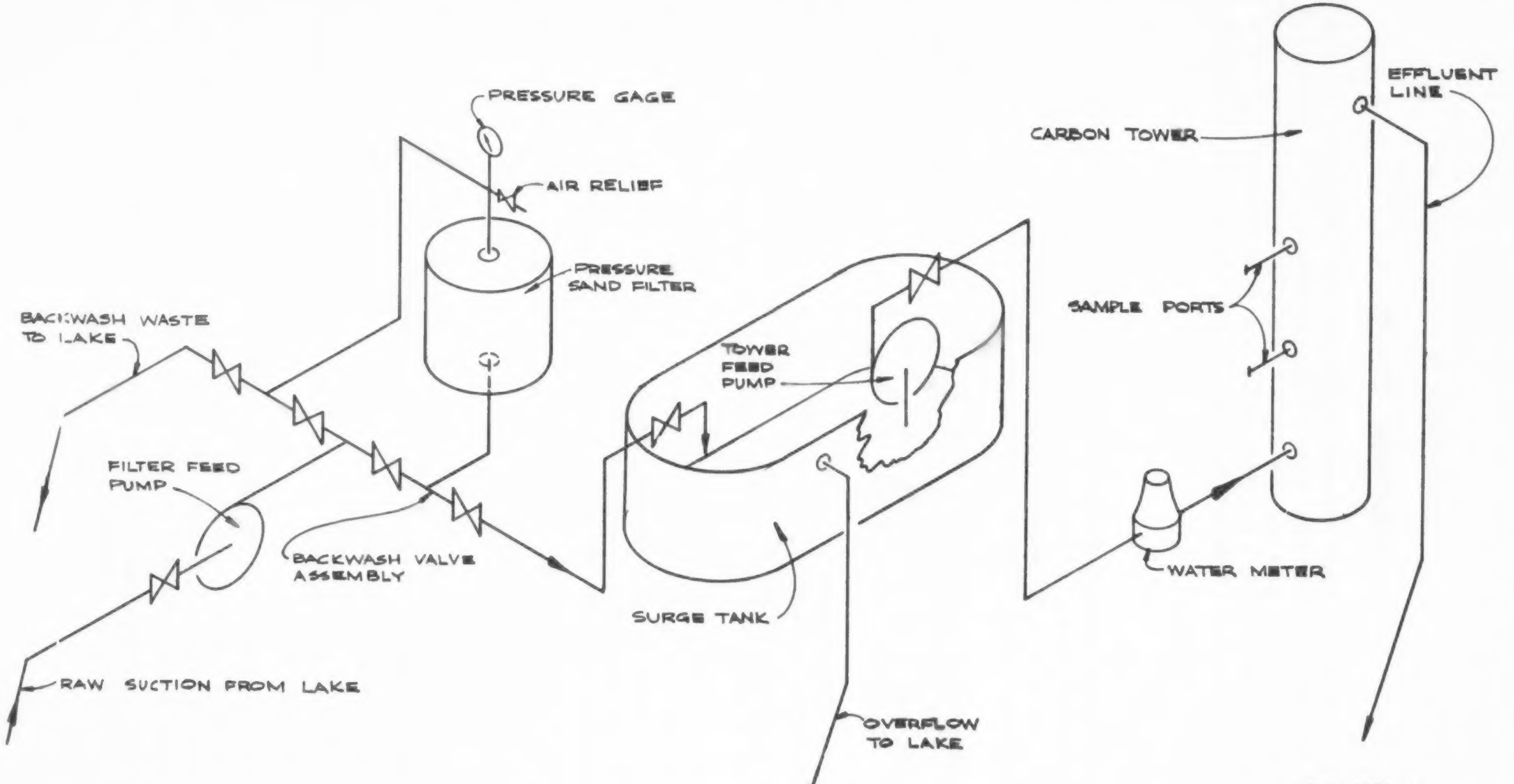

PRESSURE GAGE
AIR RELIEF
PRESSURE SAND FILTER
BACKWASH WASTE TO LAKE
FILTER FEED PUMP
BACKWASH VALVE ASSEMBLY
RAW SUCTION FROM LAKE
TOWER FEED PUMP
SURGE TANK
OVERFLOW TO LAKE
CARBON TOWER
EFFLUENT LINE
SAMPLE PORTS
WATER METER

FIGURE 14

ISOMETRIC SCHEMATIC
OF
PILOT PLANT

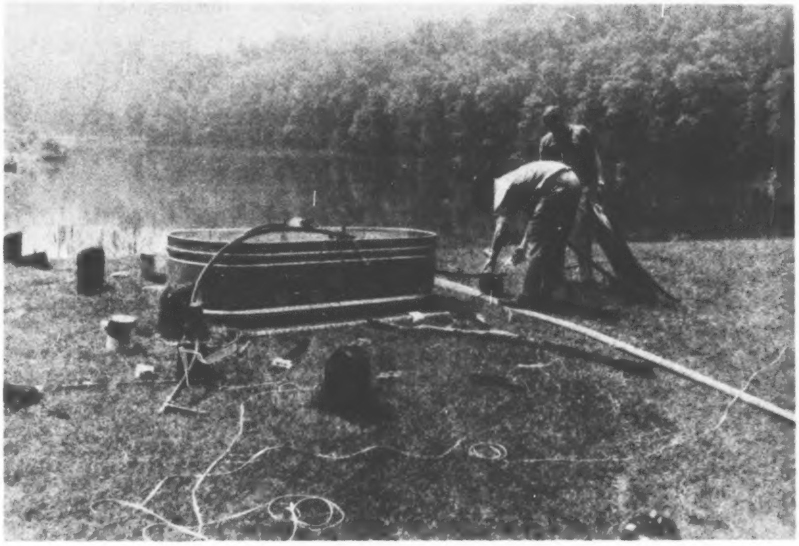


Figure 15a - Pilot plant under construction.

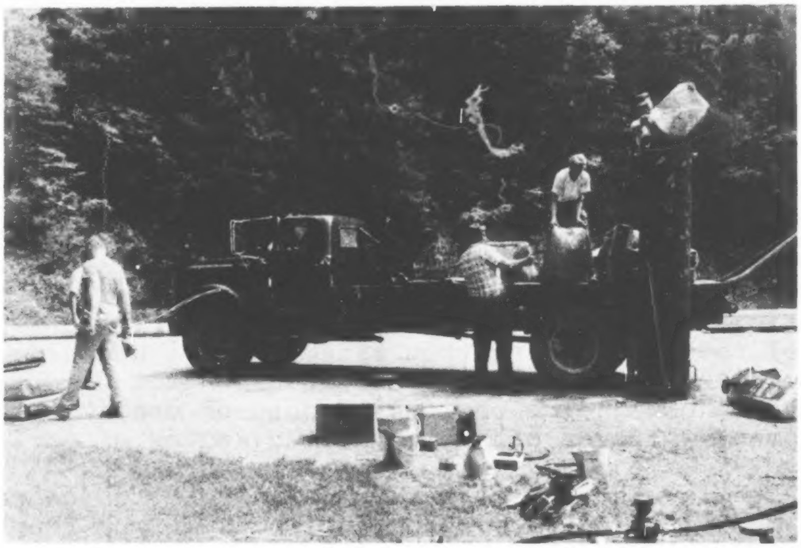


Figure 15b - Loading carbon in pilot plant column.

4. Show if a prefilter to remove organic material was needed.

5. Provide, by running until breakthrough, an estimate of the life of the carbon.

6. Demonstrate that an upflow filter assembly would provide greater carbon utilization by agitating the bed sufficiently to continuously expose fresh carbon surfaces.

7. If needed, evaluate different grades and brands of available carbons (this did not prove necessary).

The plan of operation was to take frequent samples and send them to Cincinnati for gas chromatographic analysis, with concurrent fish bioassays at the site, since there was not a chromatograph available at the site at that time. By Wednesday afternoon the Department of Natural Resources had located a G.C. at Ohio State University which was available for use at the site. It was moved to the site and installed between 1:30 a.m. and 4:00 a.m. Thursday, as described in the critical decisions section.

The pilot plant showed the available carbon was effective and Thursday afternoon Dr. Thompson made the decision to build a prototype plant to treat the entire lake. The pilot plant was kept in operation to find the capacity of the carbon bed and ran until June 25 without reaching breakthrough. A power failure occurred due to heavy rains on June 25, and in restarting the pilot plant after the power was restored, a high flow rate occurred which washed the carbon out of the column, destroying the pilot plant. Its operation was terminated shortly thereafter.

Design of Prototype Plant

The upflow carbon filter was designed by first determining what basic equipment that might possibly be used was available, and then applying the design parameters obtained in the pilot plant study to this equipment to calculate the rate at which this system could treat the lake water. Since the resulting rate was found to be acceptable, the auxiliary portions of the system were then sized and all necessary parts listed and either obtained or redesigned so that existing parts could be used. The obvious purpose of utilizing available equipment wherever possible was the saving of time.

The first item sought was a tank or basin to hold the carbon. Temporary modification of portions of the spillway from the lake was an early consideration. On-site construction of a wooden frame for holding the carbon was also contemplated. In the search for a tank, Dr. Thompson, in discussion with

Dr. Sid Hana of Cincinnati EPA, discovered that some wooden tanks of 3" thick cypress with inside dimensions of 4' x 18' x 7' high, which had previously been constructed for research in water treatment, were owned by EPA and located in Cincinnati. The State quickly provided an airplane to transport Dr. Thompson to Cincinnati to inspect the units and dispatched a flat-bed truck to the city to save time if the tank proved to be satisfactory. Dr. Thompson located and measured a suitable unit and made necessary arrangements for its use. Had the tanks been unsuitable, he would have cancelled the trucks by radio from his plane.

The pilot plant had operated well up to a rate of 7.5 gpm, which was a volumetric loading rate of 0.5 gpm/ft^3 and a surface loading of 3.5 gpm/ft^2. Above 8.0 gpm, there was increased expansion of the bed and lift out of the carbon through the top restraint. The available depth in the large tank was only 6 feet, compared to 7 feet in the pilot plant unit. This resulted in a lower surface loading and decreased tendency for the carbon to be lost in the upflow at the same volumetric loading of 0.5 gpm/ft^3. The total flow corresponding to the design rate was 216 gpm, or approximately 1/3 mgd. The maximum permissible flow through the filter was calculated to be 225 gpm.

The decision was made to use one of these tanks on Thursday afternoon and it was delivered on Thursday night at 11:30 p.m. Until the box was examined more closely for location of reinforcing bars and joints, very little of the design of inlet and outlet piping could be done. The tank was sent to the garage at the Shawnee State Forest headquarters, where welding equipment and other facilities were available.

Preliminary design sketches prepared by Dr. Cecil Lue-Hing and Joe Dieterman showed dual 8" diameter PVC inlet manifolds running the entire length of the box and resting on the bottom. They were spaced with centers one foot from the two sidewalls and drilled on both sides with 1/2" diameter holes every 6". The weight of the filter material was supported on three rows of concrete blocks spaced at 2' centers, covered by expanded metal grating, 1/8" grid hardware cloth, and muslin. The 6' bed of activated carbon was shown to be covered by another layer of muslin to separate the carbon from a 4" layer of vermiculite on top. The purpose of the vermiculite was to provide a cushion against excessive packing of the carbon. The filter bed was held in place by reverse construction of the filter bottom - muslin, 1/8" grid hardware cloth, and finally expanded metal grating. Two by four stringers placed upright at 24" intervals held the filter top secure and the water level was maintained above the filter box by adding

2 x 12 boards as risers on three sides of the tank. One end of the tank top was shown as an overflow weir, with the flow being caught in an overflow box which emptied through a bottom effluent pipe. The tank and risers were lined with continuous plastic liner to minimize leakage. A copy of this field design sketch is presented in Figure 16. The map sketch, Figure 10, shows the location of the pump and filter at the lake.

The activated carbon specified was that used in the pilot plant - Calgon Filtrasorb 400, 12 x 40 mesh. Calgon representatives had verified that the quantity required, approximately 26,000 lbs., was available from a production facility in nearby Catlettsburg, Kentucky. They also indicated that they would repurchase the spent carbon.

Inlet piping was also originally specified as 8" PVC pipe, with the two manifolds under the filter combining at a Y section, which then changed to metal plumbing with an 8" globe valve. However, it was soon determined that the large pipe sizes and fittings would not be obtainable from stock. The design was modified to 6" PVC manifold pipes in the filter coming out into an elbow and a tee-section with the common header valved with a 4" gate valve. Galvanized piping upstream from the valve were shown as a flow meter, a tee-section leading to a by-pass (also with a gate valve), and a connection onto the fire hose from the pump. All these fittings were originally designed as 4", but the use of a 3" meter with its extremely high head loss compared to the remainder of the fittings made the use of 3" piping much more reasonable. The meter was loaned to the project by the Portsmouth Water Department.

A pump with approximately the head-discharge characteristics needed for the filter system was already owned by the Ohio DNR and located in Chillicothe. The pump, powered by a gasoline engine, was used very infrequently to flood marshes and was stand-by equipment for fire-fighting. The pump was fitted to use 2-1/2" fire hose on the discharge side and 4" hard rubber hose on the intake side. A strainer and float for the intake were also designed.

Although a pressure sand filter had been used in the pilot plant to protect the carbon column from suspended solids in the lake water, the decision was made to eliminate this unit from the full-scale treatment operation. This was primarily because of the very low suspended solids in the lake - an average turbidity of 7 units coming into the sand filter and 4 in the effluent from the pilot plant carbon filter. In three full days of operation, the pressure loss through the sand filter had not increased perceptibly.

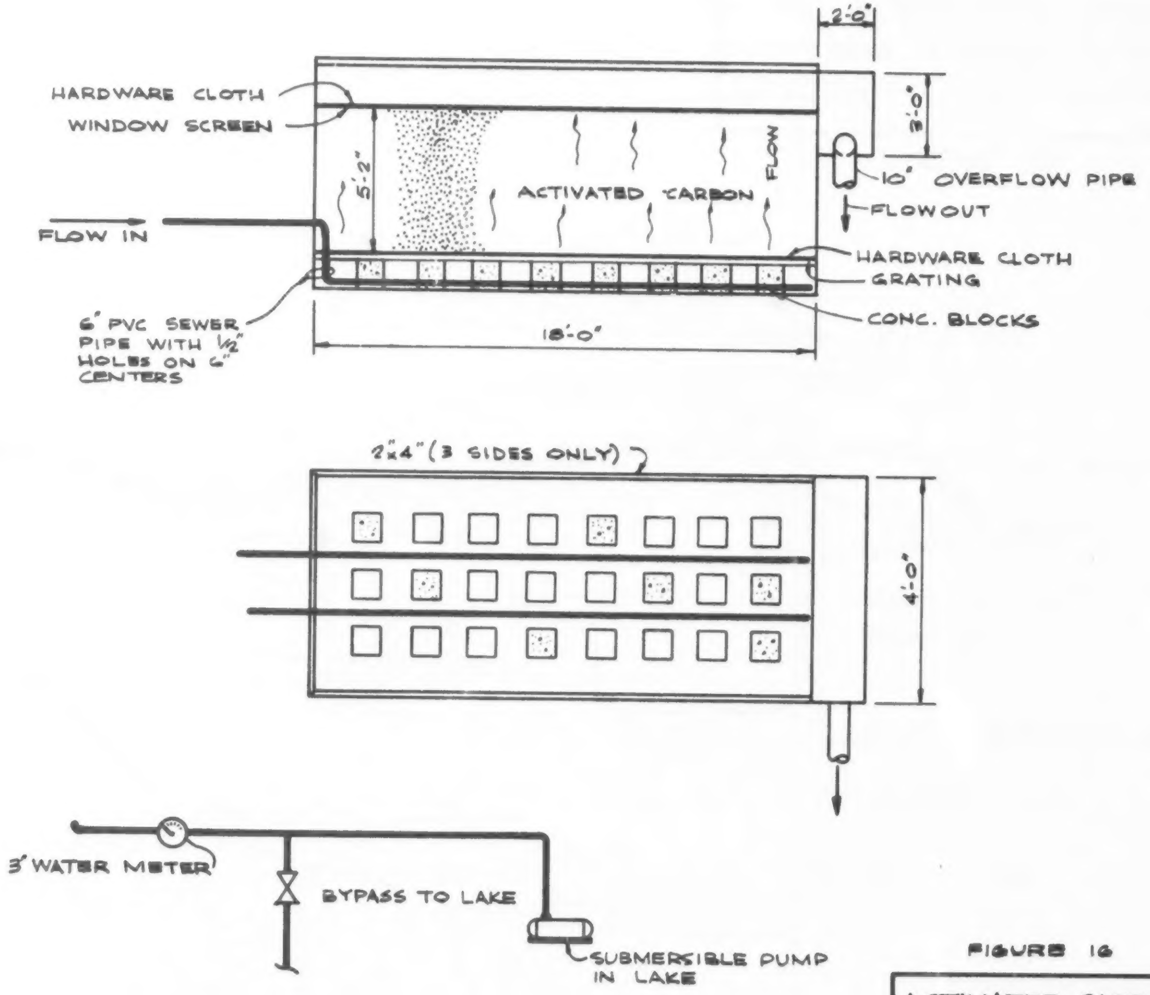
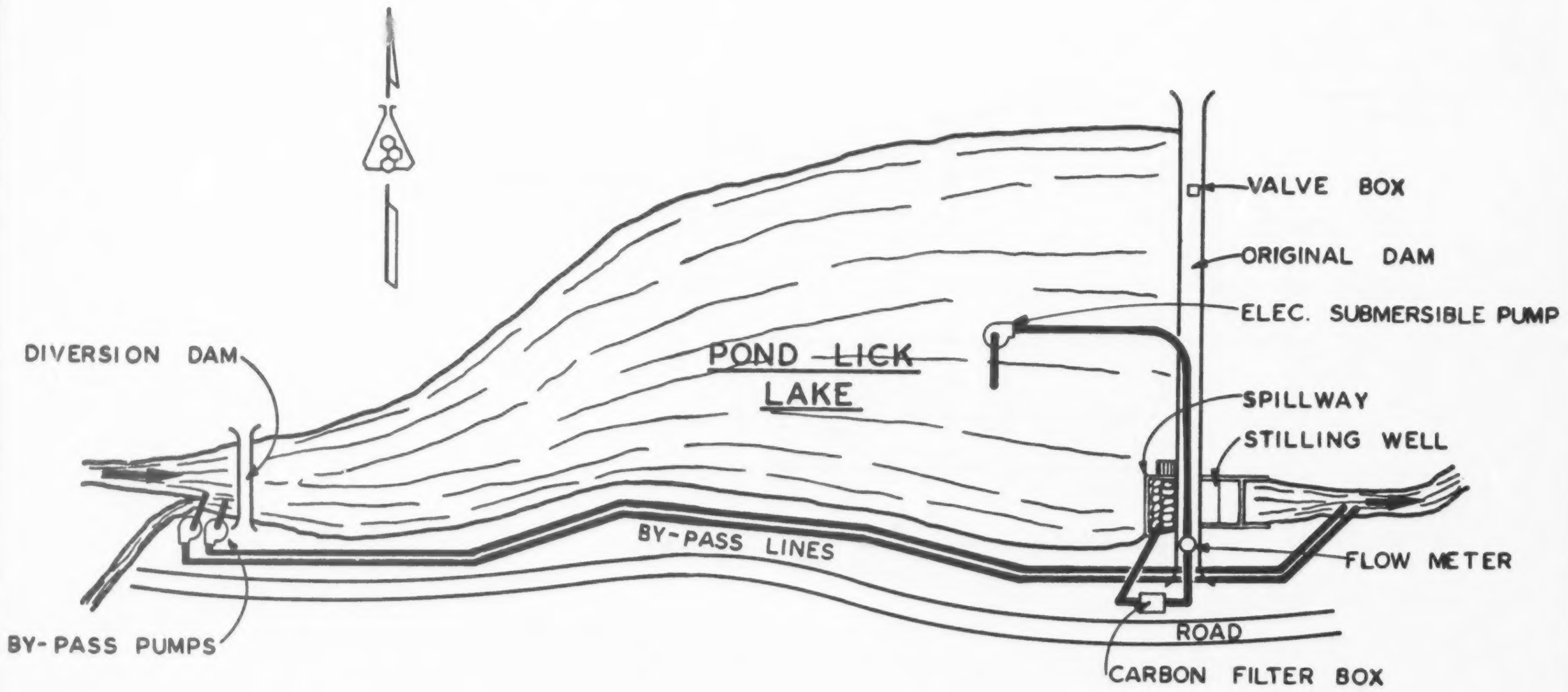

2'-0"
3'-0"
HARDWARE CLOTH
WINDOW SCREEN
5'-2"
ACTIVATED CARBON
FLOW
10" OVERFLOW PIPE
FLOWOUT
FLOW IN
HARDWARE CLOTH
GRATING
CONC. BLOCKS
6" PVC SEWER PIPE WITH 1/2" HOLES ON 6" CENTERS
18'-0"
2"x4" (3 SIDES ONLY)
4'-0"
3" WATER METER
BYPASS TO LAKE
SUBMERSIBLE PUMP IN LAKE

FIGURE 16

ACTIVATED CARBON
FILTER FOR POND
LICK RESERVOIR



DIVERSION DAM
POND LICK LAKE
VALVE BOX
ORIGINAL DAM
ELEC. SUBMERSIBLE PUMP
SPILLWAY
STILLING WELL
FLOW METER
BY-PASS LINES
ROAD
CARBON FILTER BOX
BY-PASS PUMPS

FIGURE 10

PLACEMENT OF ACTIVATED
CARBON FILTER PLANT
AT POND LICK LAKE

The locations of the pump, filter, and piping were largely dictated by site conditions near the spillway. Because of the by-pass pipes lying between the roadway and the paved parking area near the spillway, it was not easily possible to place the filter in this otherwise desirable location. Therefore, it was lifted from the truck by a crane and placed almost against the pipeline at the edge of the roadway. The pump, which was readily movable because the unit was mounted on wheels, was located on a concrete pad at the edge of the spillway just a few inches above lake level. This minimized the length of suction hose needed and the suction head on the pump.

Several modifications were made from the design described above as a result of construction or operation difficulties. These changes are described in the following two subsections.

CONSTRUCTION

In order to accommodate the concrete blocks between the sidewalls of the tank and the inlet manifolds, the PVC pipes were actually placed close to the third points across the bottom rather than one foot from the sidewalls. After the holes for the inlet pipes were cut and the pipe inserted, held in place by brackets, and the holes sealed, the filter box was ready to be moved to the lake site. The plastic liner was installed and several existing fixtures on the box were also modified or sealed at the garage before moving the filter tank.

The box was leveled by placing wood shims under corners on the downhill side, with main emphasis on keeping the weir level. The thickest skim needed was about 2". Subsequent experience indicated that the wood was inadequate to support the weight of the tank when filled with water. The wood at the intake end of the tank crushed, resulting in a level overflow end but a torque and distortion of the tank.

The bottom screens were cut and placed in the tank with careful work at the edges and overlaps. Before the muslin was put in, a field conference was held and it was decided that the possibility of the muslin blinding with fines in the water or carbon was great enough and the difficulty in removing the muslin would be so great that the muslin should not be installed. It was decided to use a 4" layer of gravel in place of the muslin to prevent loss of carbon through the bottom screen. Some gravel was available in the State Forest. It was loaded onto a dump truck, washed, and placed in the tank without any significant time loss. A sample of the gravel was taken for later size analysis.

While the bottom was being installed, the weir plate and overflow box were also being constructed. The weir plate was simply a tin sheet molded to the top of the 3" cypress board, providing a smooth, broad-crested weir that brought the overflow away from the edge of the tank so that the overflow box could catch it. A 3' deep by 2' wide box built of spruce lumber was attached to the end of the tank at an approximate 15° angle. This permitted insertion of a section of 10" aluminum pipe into the bottom of the low side of the box to drain the box, rather than the original design of a pipe coming out of the bottom. The advantages of this change were many: no elbows would be required to direct the flow into the spillway; there was no downward force on the piping which would require a more substantial attachment to the overflow box; and a greater flow could be accommodated because of the low head loss characteristics of the revised flow design.

Before loading the activated carbon, additional cleaning of the gravel was ordered. This was accomplished by connecting the pump and inlet piping and adding the risers to the top of the tank. Two by fours placed flat to hold the plastic liner topped by 2 x 4's on edge were used for risers instead of the 2 x 12 planks originally specified. The flat 2 x 4's were to restrain the upward movement of the screen edges and prevent bubbling of carbon along the walls, a problem encountered in the pilot plant.

Flow of water through upflow unit cleaned the gravel within 15 minutes and also showed leaks. Most of these were between sideboards in the filter which would swell shut within a day. Some of the larger cracks were caulked with waterproofing compound. However, the major leaks were at the joints in the PVC inlet piping. These were later repaired by S. J. Ryckman and Dr. Thompson when the tank was drained by mixing a patching compound of the sealant used for the PVC pipes and ground PVC. This paste was built into a 45° weld around all the joints and then covered by a black plastic tape, followed by nylon filament strapping tape. Dr. Thompson also ordered a complete new manifold in case of failure of the joints.

The carbon was then added to the tank filled with water. Trucks full of 60 lb. bags of the carbon were parked next to the side of the tank. Temporary scaffolds were laid along the top of the filter to permit the workers to easily move about the top. The bags were handed to the workers on top, who cut holes in the bags and permitted the carbon to empty from the bags slightly submerged. This procedure eliminated much of the dust problem usually associated with handling carbon and gave uniform density in packing of the bed. When the carbon was nearly at overflow level, about a foot of water was drained from the tank. The bed could then be walked on without any significant compaction. The surface was leveled with rakes and the water surface again raised to the top of the carbon for the final leveling process, using the water level as a guide.

Again because of possible blinding, the muslin between the carbon and vermiculite layers was eliminated. It was decided that separation of the vermiculite from the carbon could be achieved by floatation of the lighter vermiculite. Four inches of dry vermiculite was spread over the drained carbon bed and a layer of muslin spread over the top, with the edges lapped over the filter walls to eliminate leakage of filter material. The two restraining screens were next added, followed by 2 x 4 stringers notched to fit partly under the protruding 2 x 4's in the riser section. The filter was then ready for operation.

OPERATION

Lake water was started through the filter at 5:10 p.m. on June 19. The pump had been operating for several hours at about 180 gpm, with the flow bypassed back into the lake. The initial flow rate of 40 gpm was achieved by opening the valve to the filter and then partially closing the bypass. The effluent at first contained many carbon fines and had a gray color. However, there was no boiling or carbon leakage. The pressure gauge on the inlet read 2-1/2 psi, as it continued to do throughout the start-up and early operation of the plant, indicating that the total head loss through the filter was only slightly above the static head.

A record of filter operation was started and has since been maintained. The first week's record is presented in Appendix F.

Soon after flow was started through the filter, the need for one change became obvious. The 2 x 4 braces on the filter top obstructed the flow along the top to the extent that the water level at the inlet end was four to five inches higher than at the overflow. This variation in heads would affect the flow pattern up through the filter and nearly resulted in overflowing the filter wall at the inlet end. Notches and eventually rectangular sections were removed from the braces to minimize the surface differential along the filter top.

Subsequent increases in the loading rate on the filter revealed other problems with the filter top. At rates above 90-100 gpm, large amounts of carbon leaked around the edges of the muslin. When the muslin was attached to the walls with wooden strips to eliminate the leakage, the screen began to bulge upward in the center where it was not restrained by braces. An attempt to increase the flow to the design rate (215 gpm) at 6:30 a.m. on June 20 resulted in the structural failure of the top as the braces were pushed out and the screens dislodged.

Dismantling of the top showed the cause of the failure. Disintegrated vermiculite granules had created a layer of pasty consistency of 1/16 to 1/8" thickness on the entire surface of the muslin cloth. Blinding of the cloth had caused the pressure build-up.

The decision was immediately made to remove the muslin and vermiculite and replace it with a fine mesh screen and possibly sand and gravel to prevent the carbon from escaping. Instead of floating the vermiculite to separate it from the carbon, it was scraped off the top with shovels. Six inches of carbon was also removed to provide space for the sand and gravel layers, if needed. The remaining carbon bed depth of 5'2" would accommodate a flow rate of 187 gpm under design conditions, as shown in Appendix F, Section 6.

To facilitate any further removal of the filter top, it was constructed as an integral unit and then slid into position and secured. Two by fours were used to construct the frame, to which the 40 -mesh screen was stapled. In place, the frame rested on the unexpanded carbon bed and left 4" of the freeboard to the screen for bed expansion. The hardware cloth and expanded steel grating were placed on top of the screen and held in place by another frame similar to the bottom one that was nailed to the sidewalls of the tank to prevent leakage of carbon around the edges. No sand or gravel was added until the screen was tested by itself.

The start-up procedure of slowly increasing the flow rate was again used. Because the carbon fines had been removed during the previous operation of the carbon bed, very little turbidity was observed. At first, however, small carbon granules rose through the screen and then redeposited on top of the screen. The total loss of carbon due to this problem was only about 1/2 foot^3, all during the first 30 minutes after start-up. Consequently, no sand or gravel was added.

As the flow was increased to about 100 gpm, another potential operational problem was noted. Large air bubbles rose through the filter and escaped at the same places on the top at frequent intervals. The amount of bubbling increased proportionately with the flow rate.

To keep the bubbles from forming channels through the carbon, injection of more carbon into the filter was first attempted as a countermeasure. To accomplish this, operation of the filter was temporarily halted and the water level drawn down about three feet. A three inch diameter hole was cut through the sidewall just above the lowered water level and a flange, nipple, and gate valve were attached to the outside of the hole. The original water level was restored and carbon slurry was then pumped from a 55 gallon drum into the tank with a trash pump. Three 60-lb. bags were added near the overflow end of the filter by this technique. The injection brought the unexpanded carbon bed up to the screen in the portion of the filter where the addition occurred.

The added carbon did not reduce the bubbling, although it appeared to have repaired the channeling caused by the bubbles. During the injection process, the decision was made by the field staff to obtain a submersible electric pump to replace the gasoline-powered pump. The suction head on the exposed part of the intake piping for the pump was thought to be the source of the air in the filter system. Also, substitution of the submersible pump would increase the dependability of the system, reduce manpower requirements, and permit more versatility of intake location. For the two days it took to locate, purchase, assemble, and transport the pump to the site (June 21-June 23), operation was continued with the old pump at the highest rate which did not cause turbulent bubbling, 116 gpm.

The submersible pump was mounted on a floating platform as shown in Figure 17 so that the depth of the intake could be adjusted. Sections of fire hose were used to carry the lake water from the pump to the filter. By anchoring the platform at different locations in the lake, the pump could be moved to points were the Endrin concentrations were highest.

Before the submersible pump reached the site, Endrin concentrations in the effluent began to rise. The system was shut down and the necessary modifications for addition of the new pump were made. The gasoline-powered pump was kept in its position as a standby in case of power failure.

When the system was restarted with the submersible pump, the initial effluent samples showed very high Endrin concentrations (0.9 ppb). However, after three to four hours of

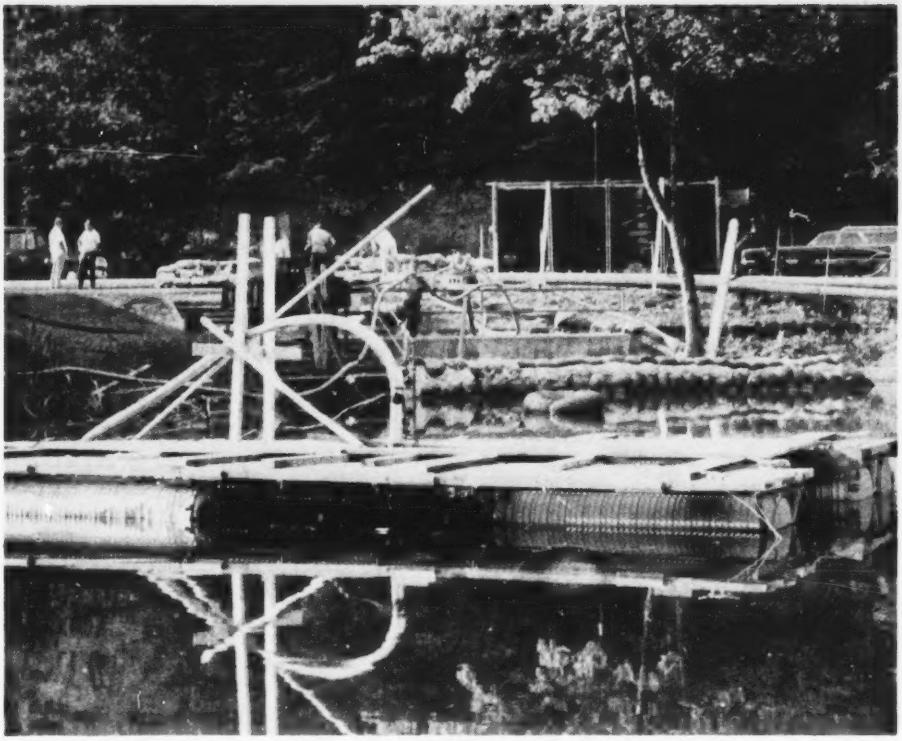


Figure 17 - Floating support for electric submersible pump installed to eliminate air bubbles in the carbon filter. Filter operated well at 180 GPM with this pump. (Courtesy Portsmouth Times)

flushing, the channels formed by the bubbling were repacked by the upflow of water and the effluent concentrations dropped to an acceptable level.

Endrin levels in the stilling basin and downstream in Pond Lick were monitored closely by G-C analysis as shown in Figure and fish bioassay to insure that the high levels did not reach the stream. A pump and hose were available at the stilling basin to repump water into the lake if high levels were detected. Because the capacity of the stilling basin was only about 20,000 gallons, or two hours detention time at 170 gpm, there was a necessity for frequent sampling of the effluent. Fish were placed in the water on top of the filter to provide rapid detection of a breakthrough. They were kept on the top by placing a screen across the overflow.

Additional protection against unexpected breakthrough was the continued operation of the pilot plant. With an approximate three-day lead time and operating at the same loading rate, the pilot plant carbon could be expected to reach its absorptive capacity before the large filter and provide a warning. However, as indicated earlier, the pilot plant ceased operation after the carbon column was partially lost in start-up after the June 26 power failure.

Notes on plant operation were prepared for the assistance of state personnel at the time that the EPA and RETA field team left the site. The notes included sampling schedules and outlines of actions to be taken in the event of possible emergencies. A copy of the notes is presented at the end of this section.

On June 21, a morning rain of 0.6 inches and an evening rain of 1.03 inches caused a total lake rise of 4 to 4-1/2 inches, but resulted in no operational problems. The bypass pumps were able to control the water level above the diversion dam and no increase in turbidity of the lake water was observed. The discharge of the pumps is shown in Figure 18. However, on the night of June 25 and early morning of June 26, a 2.15 inch downpour was recorded at the lake. Working through the night to reinforce the diversion dam and keep the water above it pumped down, the state DNR employees were finally forced to cut a trench through it to prevent the entire dam from being lost. The lake level rose rapidly, causing a need for additional sandbags around the spillway. The final increase in lake level from the rain was 18 inches.

The rainstorm created additional difficulties. For nine hours Friday night and four hours Saturday night, there was loss of electrical power at the site. This resulted in lightning problems and inactivated the submersible pump. In addition, the work on the diversion dam and rapid runoff into the lake caused high turbidity, especially at the upper end of the lake.

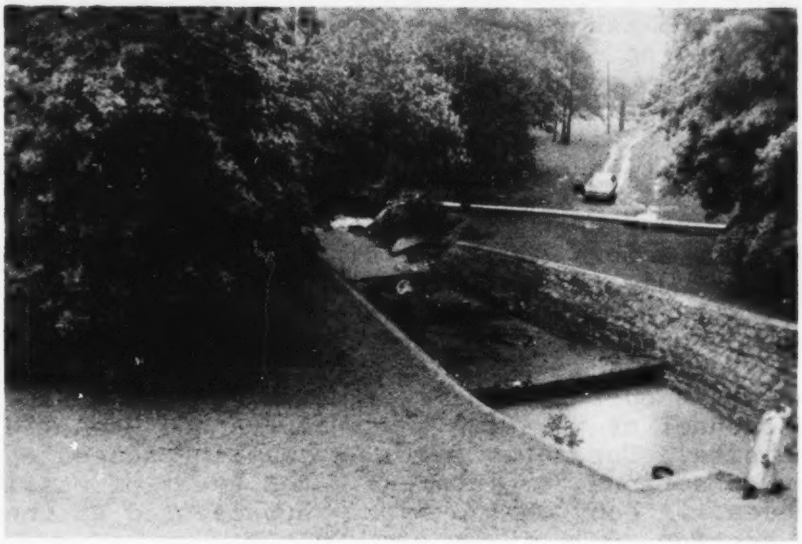


Figure 18 - Spillway of dam and discharge of by-pass pipe during heavy rain.

The turbidity was severe enough to have caused shut-down of the carbon filter, but the filter was already out of operation because of the power failure.

As the lake level continued to rise on the morning of June 26, and the possibility of the lake water either topping or breaking through the sandbags around the spillway appeared imminent, an emergency treatment system that could be placed somewhere down-stream from the lake overflow was sought. After consulting with Dr. Thompson by telephone, the state DNR personnel began construction of an upflow filter in the spillway chute by damming the chute, placing a surface baffle upstream, and packing the section of the chute between the dam and the baffle with 200 bags of activated carbon.

Lake water was directed into the emergency filter by siphoning from the lake into the spillway. No meter or accurate measurement of flow could be obtained, but the siphoning rate was estimated at 200 gpm.

Before power was restored, the effluent pipe from the large carbon filter was redirected and extended to run over the dam and discharge below the emergency filter in the chute. The turbidity in the lake subsided considerably by the time power was restored, especially near the surface. Therefore, the filter was re-started soon thereafter. High concentrations of Endrin in the effluent were again measured at the start-up, but were flushed out within the same three-hours' period as before. Because of the apparent efficient performance of the emergency filter and the need to lower the lake level rapidly, both systems have been operative since that time, resulting in a combined treatment rate of approximately 400 gpm. The corresponding draw-down of lake level has been about 4 inches per day.

NOTES ON OPERATION
OF CARBON FILTER PLANT

Pond Lick Reservoir
June 25, 1971

Prepared by:

Ken Axetell
Dave Stoltenberg

Section	Contents
1	Routine Monitoring
2	Start-up and Shut-down Procedures
3	Plant Operating Procedures
4	Emergency Procedures
5	Instructions for Recharging Filter

Routine Monitoring

Routine monitoring will be primarily by gas chromatographic analysis of samples for endrin and by fish bioassay. Monitoring of lake water and discharge is primarily fish bioassay and gas chromatographic analysis for endrin. The specific test for endrin requires about 1 1/2 hours analysis time. Results of fish killed by the endrin are measured at 24 and 48 hours. These two analyses are the only means being used to determine whether the lake water is being treated adequately.

Filter Start-up Period - For the first 5 days of operation (June 23 - June 27), samples should be taken at frequent intervals. The recommended schedule is given below:

In the lake -

a) one vertical profile every other day on the north side of the lake near the dam. Depths of 0', 3', 5', 7', and 15'

b) surface grid of lake every day at the following locations: upper end of lake, center of lake, location of vertical profile, and intake to filter plant

c) if concentration at intake has been varying significantly (over 2 ppb), take a second intake sample during the day

d) when the lake level has receded about 1', take sediment samples from the exposed bank to determine the need for washing the shore line of deposited endrin

Effluents -

a) filter plant effluents at approximate 3-hour intervals around the clock

b) two pilot plant samples per day, preferably morning and evening

Stream samples -

a) daily samples at stilling basin, bioassay shed, and at bridge over Pond Lick
b) one sample per day at other fish bioassay locations

Be certain not to contaminate samples by placing hands or objects into the samples or their containers.

Normal Operation - After the filter system has reached equilibrium, fewer samples will be required to monitor the unit. Upset in either the filter or the lake or stream may necessitate a return to the more frequent sampling schedule.

In the lake -

a) vertical profile as described above every fifth day
b) surface grid of the lake as described above every other day
c) intake sample every day (this is included in surface grid every other day)

Effluents -

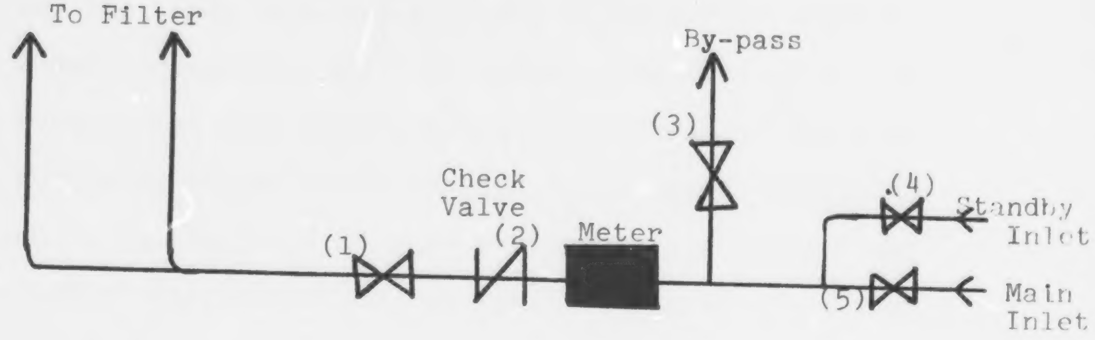
a) filter plant effluents at 6-hour intervals
b) one pilot plant sample per day

Stream samples -

a) one sample per day at every bioassay location
b) sample every other day at stilling basin, bioassay shed,

and bridge when there is no bioassay in progress at the site

Start-up and Shut-down Procedures



Start-up

Gate valve (1) should be closed.

Gate valve (3) should be open.

Gate valve (4) should be closed.

Gate valve (5) should be open.

1. Throw pump disconnect switch to "on" position.
2. Gradually open gate valve (1) to fully opened position.
3. Throttle gate valve (3) to obtain desired flow (check on flow meter).
4. Step #3 should be done over a 15-30 minute period.
5. If possible, another person should be located on filter top to observe possible velocity currents and/or bubbles.

Shut-down

1. Open by-pass valve (3) to fully opened position.
2. Close gate valve (1).
3. Shut off pump at disconnect switch on telephone pole.

Plant Operating Procedures

1. Total flow readings should be taken periodically, preferably at the times of effluent sampling. The readings should be recorded in the table shown on the next page, and the other values in the table filled in. Any noteworthy events which occurred in the filter system should also be recorded in the "REMARKS" column. One copy of these tables should be kept at the filter site and others sent to the Division of Natural Resources Columbus office and EPA Evansville office.
2. If operation at high flow rates continues to give effluent concentrations exceeding 0.4 ppb of endrin, more carbon should be injected into the filter by the same procedure used on June 22. Additional injection points should be drilled at the middle and inlet end of the filter.
3. Lake level should be recorded at the same time each day on a separate data sheet to indicate lake drawdown rate.
4. The expected decrease in maximum flow rate caused by addition of each 40 foot section of intake piping (fire hose) would be 15 to 20 gpm.

FILTER OPERATION CHART

Date	Time	Hours of Operation	Large Meter	Small Meter	Flow, Total	Gallons Since Last Reading	Flow Rate, gpm	Effluent Endrin, ppb	Remarks

Emergency Contingencies

Emergency	Corresponding Action
1. turbidity increase in lake	a. shut down filter plant
	b. if only moderate, keep pilot plant in operation to determine fouling effects
	c. if excessive, shut down pilot plant
	d. operator contact Dave Stoltenberg (EPA) or Jim Ryckman (RETA) Dave Stoltenberg - (812) 423-6871, X 264 Jim Ryckman - (513) 293-4353
2. power loss	a. as a precautionary measure, attempt to seal the 2 exposed couplings on the suction side of the army surplus pump
	b. turn off switch to submersible pump
	c. open by-pass valve
	d. start gas-powered pump and regulate flow by shutting down by-pass
	e. do not operate at a flow rate in excess of 180 gpm or at which bubbling occurs
	f. shut off gate valve on pilot plant inlet and remove electrical plug
3. filter effluent exceeds 0.20 ppb endrin	a. laboratory immediately notifies State operator
	b. operator checks filter top for channeling or other malfunction and checks flow rate; check for dead fish on filter top
	c. consider slowing flow rate until another effluent sample can be analyzed

Emergency Contingencies (continued)

Emergency	Corresponding Action
3. filter effluent exceeds 0.20 ppb endrin (continued)	d. step up sampling schedule to once every three hours with priority given to analyses
4. filter effluent exceeds 0.40 ppb endrin	a. divert effluent back into lake by moving pipe from spillway to lake
	b. continue monitoring effluent at 3-hour intervals
	c. if experimentation with flow rate reduction, sampling at inlet for high endrin levels, and injection of carbon slurry all fail to reduce the effluent level, the EPA personnel listed under 1d should be contacted
	d. preparation should be made for recharging the filter per the attached instructions
	e. if effluent has exceeded 0.40 ppb for more than 6 hours before pipe is diverted, downstream samples should be taken. If these also exceed 0.4 ppb, water should be released from Roosevelt Reservoir at the rate of 5 MGD for 8 hours
5. inlet pipe failure	a. shut off pump
	b. if failure is in PVC pipe section, attempt to keep split section intact and drain filter through 1" line. Replace PVC inlet piping with the entire replacement section available on site.
	c. if leakage or failure is in metal pipe, isolate with gate valves, remove and replace
6. heavy rainfall	a. check to see that lake by-pass pumps are manned and that the pumps can keep the water level in the dammed-up area below dam top

Emergency Contingencies (continued)

Emergency	Corresponding Action
6. heavy rainfall (continued)	b. record rise in lake level on data sheet c. record rainfall gauge reading on data sheet d. if rainfall continues for long period (more than a day), consider possibility of using runoff flow in Pond Lick for diluting some untreated lake water which could be released into spillway

Important Phone Numbers

EPA			
Hugh Thompson	Office	(703)	557-7663
	Home	(703)	560-6491
Dave Stoltenberg	Office	(812)	423-6871, Ext. 264
	Home	(812)	477-3239
Aaron Rosen (bioassays)	Office	(513)	684-4375
OHIO			
Tom Stewart	Home	(614)	882-3706
RETA			
Jim Ryckman	Office	(513)	229-3847
	Home	(513)	293-4353
St. Louis Office (Cecil Lu-Hing, Joe Dieterman)		(314)	862-3424
Ken Axetell	Office	(703)	893-8410
	Home	(703)	560-0218
Number at lab		(614)	858-5950

Instructions for Recharging Filter

1. Follow standard shut-down procedure.
2. Drain filter through 1" line.
3. While filter is draining, remove filter top by removing lateral braces, prying 2 x 4 strips away from side walls, and sliding screen and its support member out the overflow-end of filter.
4. Contact Calgon representative (Al Gaber, Calgon Center, P. O. Box 1346, Pittsburgh, Pa. 15230, (412) 923-2345) concerning trucking arrangements for return of carbon.
5. Line dump truck bed and walls with muslin and pull truck to side of filter.
6. Shovel the moist carbon into the truck bed, taking care that the workers minimize contact with the carbon. All should be protected with waterproof boots, long-sleeved shirts, and gloves.
7. Do not disturb gravel underflow system and keep workers off the top of PVC pipe inlet manifolds.
8. Refill the tank with lake water.
9. Add carbon by the same method used for originally filling the tank.
10. Draw water level down to height of screen frame bottom and level the carbon bed using the water surface as a guide.
11. Replace filter top and use standard start-up procedure.

APPENDIX F

FIELD DATA

There are 7 sections of data presented in this Appendix. This data was collected by Federal, State and RETA personnel and transmitted to St. Louis for incorporation in this report. This is all the data received by RETA.

Section 1 contains a map sketch of Pond Lick Lake with sampling locations in the lake shown. The symbols shown there match fish bioassay, temperature profile and gas chromatography analysis tables throughout this Appendix.

Section 2 is gas chromatography data run at Taft Center, Section 3 contains results of early fish bioassay tests to determine the extent of kill. These data depict a gradual decrease of Endrin concentration with increasing depth. When compared with the temperature data in Section 4, the figures show that the temperature gradient was at least partly responsible. Section 5 shows a biological survey of the watercourse conducted by EPA.

Section 6 shows pilot plant data and notes which were used to design the prototype plant.

Section 7 contains notes on operation of the prototype as well as the effluent concentrations of the filter. These analyses were the quality control on the filter and were used to determine if discharge of the effluent was possible or if it needed to be recycled to the lake until the filter operation improved.

SECTION 1

SAMPLE LOCATION MAP

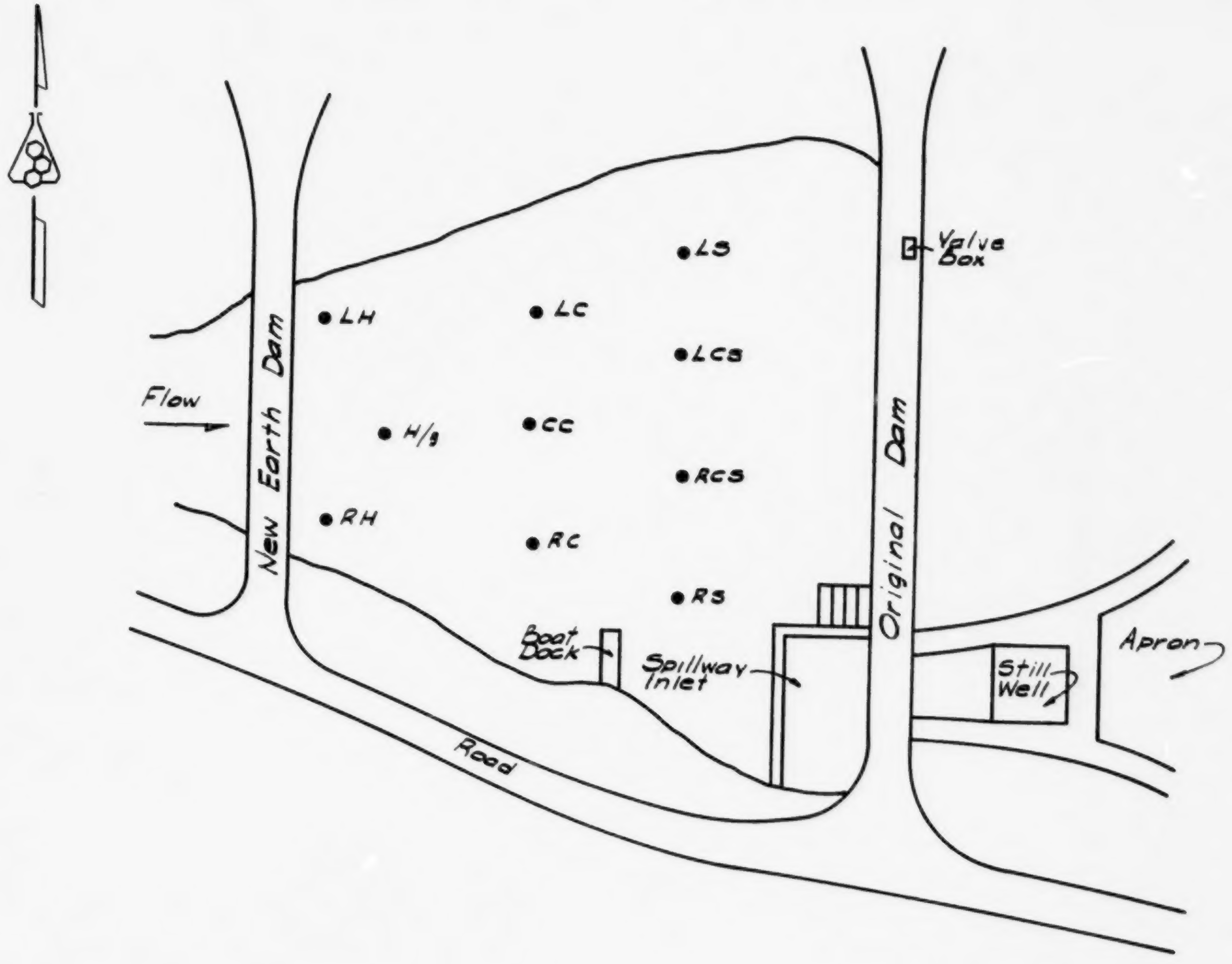

Flow
New Earth Dam
LH
H/3
RH
LC
CC
RC
LS
LCS
RCS
RS
Valve Box
Original Dam
Boat Dock
Spillway Inlet
Still Well
Apron
Road

Figure 19

Pond Lick Reservoir
Sample Points

SECTION 2
GAS CHROMATOGRAPH ANALYSIS

Taft Center, Cincinnati, Ohio

Date 6/15/71

No.	Sample Location	Conc. ppb	Remarks
	RIGHT DAM		
	Surface	6.8	After pumping stilling well into right dam
	5'	6.9	
	10'	2.1	
	14'	0.1	
	MID DAM		
	Surface	7.0	
	5'	6.5	
	10'	0.7	
	15'	0.3	
	LEFT DAM		
	Surface	6.7	
	5'	6.5	
	10'	0.8	
	15'	0.1	
	POWER LINE		
	Surface	6.3	
	5'	7.0	
	RIGHT CENTER		
	Surface	7.4	
	5'	7.0	
	10'	0.5	
	LEFT CENTER		
	Surface	7.5	
	5'	7.1	
	10'	0.3	

OTHER ENDRIN SAMPLES

DATE	TIME	SAMPLE #	$[\text{ENDRIN}]_{\text{ppb}}$	LOCATION	DEPTH
6-10			9.6	30' below spillway	
6-18	--	C22	3.565	H/3	5'
6-16	--	B23	--	LS	15'
6-19	--	B24	4.050	LS	5'
19	--	B25	--	LS	15'
18	--	28	0.375	bottom near center of dam	
19	--	34	3.665	Intake	5'
19	--	B36	0.667	LS	7'
	--	B37	9.083	LS	3'
20	--	B46	7.200	LS	5'
19	--	C47	5.950	H/3	5'
21	--	B67	7.050	LS	3'
		B68	9.050	LS	5'
		B69	6.900	LS	7'
		B70	0.750	LS	15'
		B71	8.200	LS	0'
21	--	C72	7.400	H/3	1'
22	1800	B84	6.200	LS	0'
	1800	B85	6.100	LS	3'
	1800	B86	0.500	LS	15'
	1800	B87	6.100	LS	7'
	1800	B88	6.150	LS	5'
22	1800	C89	7.100	H/3	0'
23	1730	B102	7.300	LS	0'
	1730	B103	7.200		3'
	1730	B104	7.300		5'
	1730	B105	4.400		7'
	1730	B107	0.600		15'
23	1730	C108	7.300	H/3	0'

ENDRIN CONCENTRATION AT INTAKE

DATE	TIME	SAMPLE #	[ENDRIN] ppB	
6-17	0030	A1	8.795	Initial lake sample run at lab
6-18		16	3.100	
	0300	A19	3.450	
6-19	?	31	3.800	
	?	27	10.750	
6-20	1605	40	5.333	
6-21	1615	77	7.800	In surge tank
6-22	1030	76	7.650	
	1630	82	6.150	
6-23	0800	92	6.850	
	1130	98	6.900	

SECTION 3

FISH BIOASSAY ANALYSIS

First set of samples
Time Test Set Up 16:30 Date 6/13/71

L = lethal D = distress A = active C = calm

No.	Sample Location	0 - 4 Hours	4 - 8 Hours	8 - 12 Hours	12 - 24 Hours	Remarks
LS	Spillway off drainpipe	3C	3C		1L,2D	3L 30+ hrs.
	3:1 dilution					
	5'	2L,1D	3L			
	10'	3C		1L,2A		3L 24+ hrs
	15'	3C	3C		3C	3C 96+ hrs.
H/3	H/3 @ power line center					
	Surface		3L			
	5'		3L			
	Center - 25' below earth dam, turbid		3L			

FISH BIOASSAY ANALYSIS

Time Test Set Up 22:30 Date 6/13/71

L = lethal D = distress A = active C = calm

No.	Sample Location	0 - 4 Hours	4 - 8 Hours	8 - 12 Hours	12 - 24 Hours	Remarks
LS	Spillway off drainpipe					
	Surface 2:1 dilution			3L		
	Surface undiluted	3D	3L			
	5'	1D	2L	3L		
	10'				1D,2L	
	15'				3C	
H/3	Center line					
	Surface	3L				
	5'			3L		
	Inflow above earth dam	1D	3L			
	Dilution water upstream 200' from earth dam			1L	2C	
	Spillway effluent after carbon			1L	3L	

FISH BIOASSAY ANALYSIS

Time Test Set Up 10:30 Date 6/14/71

L = lethal D = distress A = active C = calm

No.	Sample Location	0 - 4 Hours	4 - 8 Hours	8 - 12 Hours	12 - 24 Hours	Remarks
	Below stillwell approx. 200'	1L		2L,1D	3L	Minnows in bait bucket were dying readily, suggesting a poor lot of fish
	Below stillwell approx. .8 mile downstream (ballfield)			3C		
	.6 mile logging road			1C,2L		3L @ 48 hrs.
	Note: Fry in good cond. at 1 mile					
	Turkey Creek			2D,1L		
	Seepage 200 to 300' below dam			3C	3C	

FISH BIOASSAY ANALYSIS

Time Test Set Up 18:25 Date 6/14/71

L = lethal D = distress A = active C = calm

No.	Sample Location	0 - 4 Hours	4 - 8 Hours	8 - 12 Hours	12 - 24 Hours	Remarks
LS	Surface	3L				
	5'	3L				
	10'	2D			3L	
	15'	1D,2L			1D,2L	3L @ 38 hrs.
LCS	Surface	1D,2L			3L	
	5'	3D			3L	
	10'	3C			2C,1L	3L @ 38 hrs.
	15'	3C			3L	
RCS	Surface	1D,1L			3L	Stillbox pumped to RS before sample taken
	5'	1D,2L			3L	
	10'	3C			1A,3L	
	15'	3C			3L	
RS	Surface	2D.1L			3L	
	5'	3L				
	10'	2C,1L			2C,1L	3L @ 38 hrs.
	15'	3C			3C	
LC	Surface	2D,1L			3L	
	5'	2D,1L			3L	
	10'	3C			2C,1L	3L @ 38 hrs.
CC	Surface	2D,1L			3L	
	5'	1D,2L			3L	
	10'				1D,2L	
RC	Surface	2L		3L		
	5'			3L		
	10'				2C.1L	

FISH BIOASSAY ANALYSIS

Time Test Set Up 18:25 Date 6/14/71

L = lethal D = distress A = active C = calm

No.	Sample Location	0 - 4 Hours	4 - 8 Hours	8 - 12 Hours	12 - 24 Hours	Remarks
H/3	Surface	2D,1L			3L	
	5'	2D,1L			3L	
LH	Surface	3L				
	5'	1D,2L			3L	
RH	Surface	3L				
	5'	2D,1L			1C,2L	3L @ 20 hrs.
	25' from crest after stillwell was pumped	3L				
	Drainage through carbon			14 hours 2D,1L	16 hours 3L	
	Sample from above earth diversion dam				3L	
	5 minnows left in bucket, survived 18 hours					

FISH BIOASSAY ANALYSIS

Reruns
Time Test Set Up 11:00 Date 6/16/71

L = lethal D = distress A = active C = calm

No.	Sample Location	0 - 4 Hours	4 - 8 Hours	8 - 12 Hours	12 - 24 Hours	Remarks
	Dilution water of 6/13/71	3C			3C	3L @ 69 hrs.
	Above diversion dam 6/13/71	3C			3C	2L @ 69 hrs.
	LH 5' - 6/14/71	3L				
	Dam seepage at crest				3C	3C @ 69 hrs.

SECTION 4
TEMPERATURE PROFILE
POND LICK LAKE

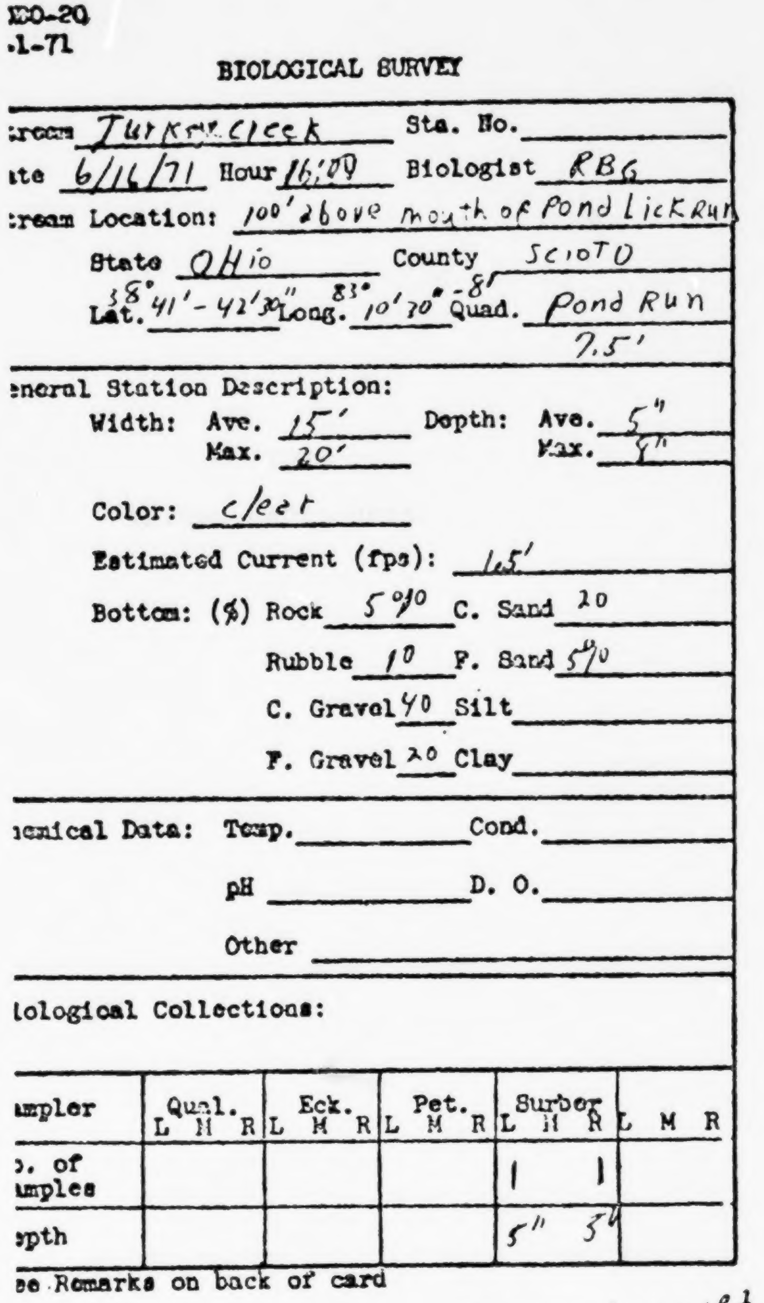
Date 6/16/71

Station	Total Depth at Station	Temperature °C			
		Surface	5'	10'	15'
LS	15'	27.5	25.0	16.5	10.5
LCS	17'	27.5	25.0	16.0	11.0
RCS	16'	27.5	25.0	16.5	11.0
RS	15'	28.0	25.5	17.0	10.5
LC	11'	27.0	24.5	16.0	
CC	11'	27.0	25.0	18.0	
RC	10'	26.5	25.5	15.5	
H/3	8'	27.0	24.5		
LH	5'	27.0	25.0		
RH	6'	27.0	25.5		

Note: Temperatures determined with thermistor probe

SECTION 5

BIOLOGICAL SURVEY



DO-20
1-71

BIOLOGICAL SURVEY

ream Turkey Creek Sta. No. ____

te 6/16/71 Hour 16:00 Biologist RBG

ream Location: 100' above mouth of Pond Lick Run

State OHio County Scioto

Lat. 38° 41' - 42'30" Long. 83° 10'30" -85 Quad. Pond Run 7.5'

neral Station Description:

Width: Ave. 15' Depth: Ave. 5"

Max. 20' Max. 8"

Color: clear

Estimated Current (fps): 1.5'

Bottom: (%) Rock 5% C. Sand 20

Rubble 10 F. Sand 5%

C. Gravel 40 Silt ____

F. Gravel 20 Clay ____

emical Data: Temp. ____ Cond. ____

pH ____ D. O. ____

Other ____

iological Collections:

ampler	Qual. L	Qual. M	Qual. R	Eck. L	Eck. M	Eck. R	Pet. L	Pet. M	Pet. R	Surber L	Surber M	Surber R	L	M	R
o. of amples										1		1			
epth										5"		3"			

e Remarks on back of card

Fry observed

Unproductive area. Frog, crayfish, water-penny, minnows and fingerlings observed.

K00-80
[illegible]

BIOLOGICAL SURVEY

Stream Pond Lick Run Sta. No. ____
Date 6/16/71 Hour 16:30 Biologist RBC
Stream Location: 100' above Pond Lick (Shawnee) lake
State OHio County SCIOTO
Lat. 38° 41'-42'30' Long. 83° 10' 30"-8' Quad. Pond Run 7.5'

General Station Description:

Width: Ave. 4 Max. 8
Depth: Ave. 3" Max. 6"

Color: Clear

Estimated Current (fps): <.5

Bottom: (%) Rock 5 C. Sand 15
Rubble 15 F. Sand 10
C. Gravel 40 Silt ____
F. Gravel 25 Clay ____

Chemical Data: Temp. ____ Cond. ____
pH ____ D. O. ____
Other ____

Biological Collections:

Sampler	Qual.			Eck.			Pet.			Surber					
	L	M	R	L	M	R	L	M	R	L	M	R	L	M	R
No. of Samples										1		1			
Depth										3"		3"			

See Remarks on back of card

Elmidae adult, crayfish, caddis, mayfly, stonefly, water penny, minnows. Relatively rich.

UOBO-20
4-1-71

BIOLOGICAL SURVEY

Stream Turkey Run Sta. No. ______

Date 6/16/71 Hour 15:30 Biologist RBG

Stream Location: 200' below mouth of Pond lick

State Ohio County Scioto

Lat. 38° 41'-42'30" Long. 83° 10' 30" -81 Quad. Pond Run 7.5'

General Station Description:

Width: Ave. 20' Max. 25'

Depth: Ave. 5" Max. 8"

Color: clear

Estimated Current (fps): 1.0 or <

Bottom: (%) Rock 5 C. Sand ______

Rubble 30 F. Sand 20

C. Gravel 30 Silt ______

F. Gravel 15 Clay ______

Chemical Data: Temp. ______ Cond. ______

pH ______ D. O. ______

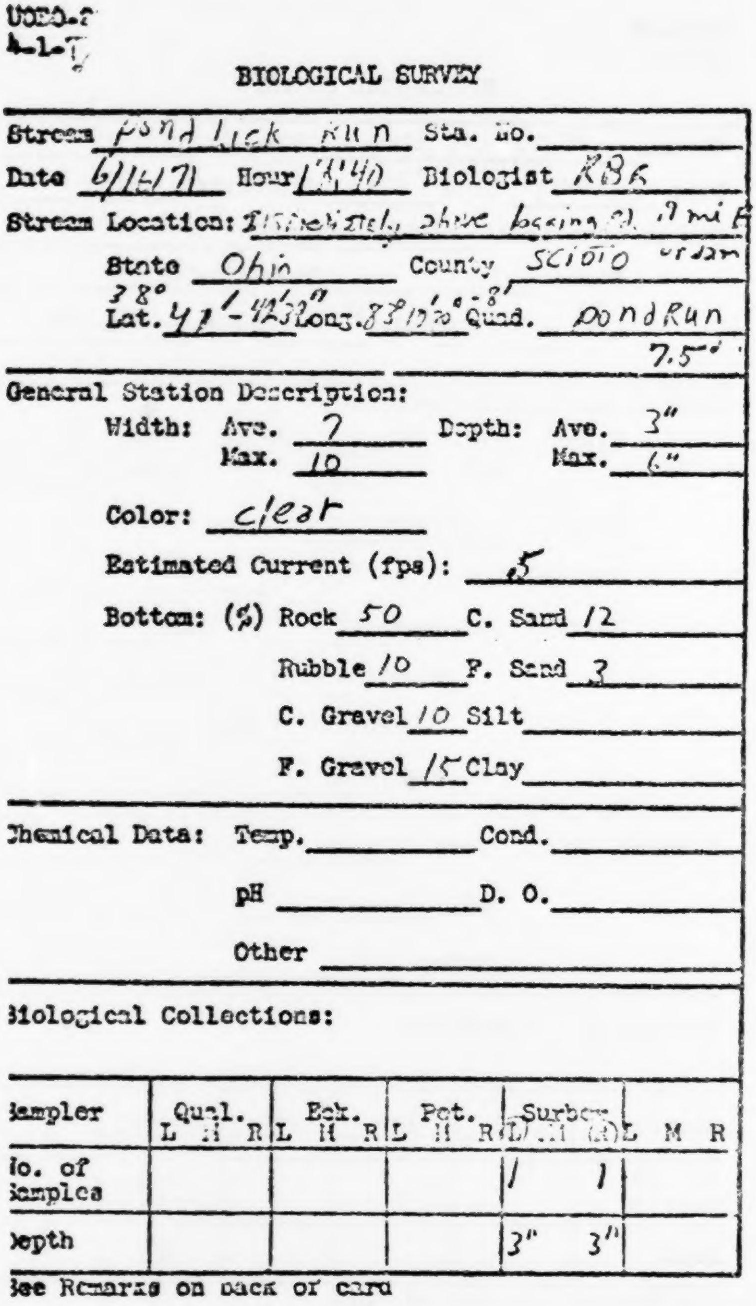
Other ______

iological Collections:

ampler	Qual. L M R	Eck. L M R	Pct. L M R	Surber L M R	 L M R
o. of amples				1 1	
epth				5" 5"	

ee Remarks on back or card

Unproductive area. Frog, crayfish, water-penny, minnows and fingerlings observed.



UCEO-F
4-1-T

BIOLOGICAL SURVEY

Stream Pond Lick Run Sta. No.

Date 6/16/71 Hour 13:40 Biologist RBK

Stream Location: Immediately above bearing Rd. .9 mi E

State Ohio County Scioto urban

Lat. 38° 41'-42'30" Long. 83°10'00"-8' Quad. Pond Run 7.5'

General Station Description:

Width: Ave. 7 Depth: Ave. 3"
Max. 10 Max. 6"

Color: clear

Estimated Current (fps): .5

Bottom: (%) Rock 50 C. Sand 12
Rubble 10 F. Sand 3
C. Gravel 10 Silt
F. Gravel 15 Clay

Chemical Data: Temp. Cond.
pH D. O.
Other

Biological Collections:

Sampler	Qual. L M R	Ekk. L M R	Pet. L M R	Surber L M R	L M R
No. of Samples				1 1	
Depth				3" 3"	

See Remarks on back of card

Shale in substrate. Caddis fly, waterpenny, elmidae, isopid, mayfly, crayfish.

UCSO-20
4-1-71

BIOLOGICAL SURVEY

Stream Pond Lick Run Sta. No.

Date 6/16/71 Hour 17:00 Biologist RBG

Stream Location: Ballfield .3 mi below dam

State OHIO County SCIOTO

Lat. 38° 41'-42'30" Long. 83° 10'30"-8' Quad. Pond Run 7.5'

General Station Description:

Width: Ave. 4 Depth: Ave. 3
Max. 6 Max. 5

Color: clear

Estimated Current (fps): <.5

Bottom: (%) Rock 10 C. Sand 10
Rubble 25 F. Sand 5
C. Gravel 30 Silt
F. Gravel 25 Clay

Chemical Data: Temp. Cond.

pH D. O.

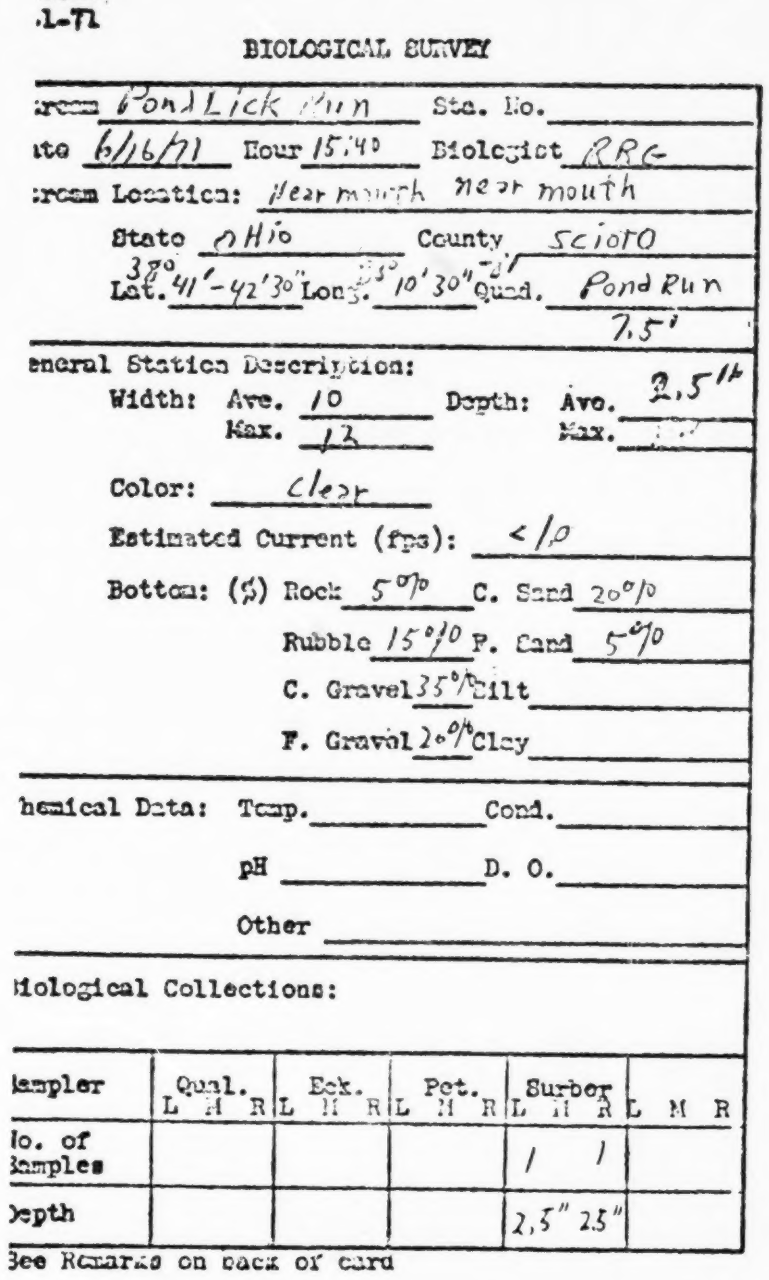
Other

Biological Collections:

Sampler	Qual. L M R	Eck. L M R	Pet. L M R	Surber L M R	 L M R
No. of Samples				2	
Depth				9"	

See Remarks on back of card

Shale dominant, poor substrate, no organisms.



BO-5
1-71

BIOLOGICAL SURVEY

ream Pond Lick Run Sta. No.

ate 6/16/71 Hour 15:40 Biologist RRG

ream Location: Near mouth near mouth

State OHio County Scioto

Lat. 38° 41'-42'30" Long. 83° 10'30" -81 Quad. Pond Run 7.5'

eneral Station Description:

Width: Ave. 10 Depth: Ave. 2.5"

Max. 12 Max.

Color: Clear

Estimated Current (fps): <1.0

Bottom: (%) Rock 5% C. Sand 20%

Rubble 15% F. Sand 5%

C. Gravel 35% Silt

F. Gravel 20% Clay

hemical Data: Temp. Cond.

pH D. O.

Other

iological Collections:

ampler	Qual. L	M	R	Eck. L	M	R	Pet. L	M	R	Surber L	M	R	L	M	R
o. of amples										1		1			
epth										2.5"		2.5"			

ee Remarks on back of card

Salamander, mayfly, waterpenny, minnows observed.

SECTION 6

PILOT PLANT DATA

POND LICK LAKE PILOT PLANT

Activated Carbon Sorption of Endrin

Carbon Volume: 10.25 Cu.Ft.
Raw Endrin: 8.7 & 9.5 (Local) 6.6ppb (Taft)
Date: 6-16-71
Time: 11:30 pm

DATE	TIME	RUNNING HOURS	FLOW METER GALLONS	FLOW LAST HOUR GALLONS	FLOW GPM	ENDRIN ppb		
						TAFT	LOCAL	
6/16/71	11:30 P	0	33290	120	Fill Up Operations			
6/17/71	12:30 A	1	33312	220	3.7		0	
		2	33332	200	3.33		0	1
		3	33377	450	7.5		0	
		4	33421	440	7.3		0	2
		5	33428	70	1.1		0	3
		6	33468	400	6.7		0	
		7	33501	330	5.5		0	
		8	33546	450	7.5		0	
		9	33590	440	7.5			
		10	33632	420	7.0			
6/17/71	10:30 A	11	33674	420	7.0			
6/18/71	3:30 P	40	34665	9910	5.7		0.050	
	5:50 P	42	34782	1170	8.35			4
	7:50 P	44	34889	1070	8.9		0.050	
	10:00 P	46.5	35002	1130	7.5			

1. Increase flow to 7.5 gpm
2. Carbon loss
3. Repair Filter
4. Pump rate down to 4 gpm; removed air lock from pump line, rate increased to 9.1 gpm. Boiling of carbon in filter, repaired; rate reduced to 7.5 gpm.

POND LICK LAKE PILOT PLANT

Activated Carbon Sorption of Endrin

Carbon Volume: 10.25 Cu.Ft.
Raw Endrin: 8.5
Date: 6-19
Time:

DATE	TIME	RUNNING HOURS	FLOW METER GALLONS	FLOW LAST HOUR GALLONS	FLOW GPM	ENDRIN ppb		
						TAFT	LOCAL	
6/19/71	3:05 A	51.5	35162	1600	5.3		0.050	1
	8:00 A	56.5	35375	2130	7.3		0.050	1,2
	12:00 A	59	35478	1030	6.9			
	3:25 P	62.5	35613	1350	6.6		0	
	7:30 P	66.5	35775	1620	6.8			
6/20/71	1:00 A	72	35993	2180	6.6			3
	4:00						0	
	7:30 P	90.5	36728	7350	6.7			
	9:30 A						0	
6/21/71	10:30 A	106.5	37361	6330	6.6			
	2:00 P	109	37459	980	6.5			
	4:30 P	111.5	37558	990	6.6			4
	7:30 P	111.5	37558					
	8:00 P	112	37580	220	7.3			
6/22/71	8:30 A	124.5	37981	4010	5.4			5
	9:10 A	125	38014	330	8.2		0.2	

1. Small carbon loss in effluent catch.

1,2. At 10:00 am shut down plant to fix gasket; restarted at 11:30 am. Diverted pilot flow to spillway side of dam.

3. No problems experienced with operation, system is in equilibrium.

4. Shut down to remove sand filter from system; start up at 7.5 gpm.

5. Flow rate adjusted to 7.5 gpm--valve had been changed during night.

POND LICK LAKE PILOT PLANT

Activated Carbon Sorption of Endrin

Carbon Volume: 10.25 Cu.Ft.
Raw Endrin: 1.95ppb; on 6/22/71, raw Endrin increased to 7.6ppb
Date: 6/22/71
Time:

DATE	TIME	RUNNING HOURS	FLOW METER GALLONS	FLOW LAST HOUR GALLONS	FLOW GPM	ENDRIN ppb		
						TAFT	LOCAL	
6/22/71	11:00 A	127	38102	880	8.0			
	1:30 P	129.5	38222	1200	8.0			
	4:30 P	132.5	38370	1480	8.2		0	1
6/23/71	8:00 A	148	38882	5120	5.5		0	
	8:30 A	148.5	38897	150	5.0			2
	11:00 A	151	38995	980	6.5			
	11:30 A		39012				0.100	
	1:30 P	153.5	39093	980	6.5			
	7:00 P	159	39308	2150	6.5			3
	8:00 P	159	39308	0				
	10:00 P		39358				0	
6/24/71	3:00 A	171	39654	3460	4.8		0	4
	2:00 P	177	39896	2420	6.7			
6/25/71	10:00 A	197	40728	8320	6.9			
	11:00 A	198	40770	420	7.0			

1. Reduced flow to 6 gpm.
2. Increased flow to 7 gpm.
3. Power plant down for 1 hour at 7:00 pm to wire in the electric motor. Restarted at 5.0 gpm.
4. Increased to 7.0 gpm at 8:00 am.

ACTIVATED CARBON LOADING RATES

PILOT PLANT

20" dia. x 7'0"
15.25 ft^3 2.18 ft^2

Flow rate, gpm	Volumetric loading gpm/ft^3	Surface loading gpm/ft^2
8*	0.52	3.7
7	0.46	3.2
6	0.39	2.8
5	0.33	2.3

* Lift out of carbon occurred at this flow rate.

(Design value 0.5gpm/ft^3 = 7.5gpm)

PROTOTYPE PLANT

18' x 4' x 5'2" = 373 ft^3
72 ft^2

Flow rate, gpm	Volumetric loading gpm/ft^3	Surface loading gpm/ft^2
220	0.59	3.1
210	0.56	2.9
200	0.54	2.8
190	0.51	2.6
		← design value
180	0.48	2.5
170	0.46	2.4
160	0.43	2.2
150	0.40	2.1
140	0.38	1.9
130	0.35	1.8
120	0.32	1.7
110	0.30	1.5
100	0.27	1.4

SECTION 7

PROTOTYPE PLANT DATA

CARBON FILTER PLANT

Date	Time	Hours of Operation	Large Meter	Small Meter	Total	Gallons Since Last Reading	Flow Rate, GPM	Effluent Endrin, ppb	Remarks
6-19	1400	-	0	0	0	0			
	1430	-			7700	7700			Fill tank and wash gravel; load with carbon
	1710	0			7700	0		0.00 (5:30 p sample)	Start of operations
	1830				8300 ?			0	Sample 32
	1930	2 1/2			14750	7050	47	0	
	2000	3			16200	1450	48		Full flow operation
	2030	3 1/2			18800	2600	87	0	Sample 35
	2045	3 3/4			21000	2200	147		Shut down to reprime pump
	2100	4			21000	0			Restart
	2130	4 1/2			25300	4300	144		
	2300	6			33800	8500	95		
6-20	0130	8 1/2			47500	13700	92	0	Sample 38
	0405							0	
	0630	13 1/2			74800	27300	91		Rate increased to 210 gpm. Filter top failed, operation ceased shortly thereafter

CARBON FILTER PLANT

Date	Time	Hours of Operation	Large Meter	Small Meter	Total	Gallons Since Last Reading	Flow Rate, GPM	Effluent Endrin, ppb	Remarks
6-20	1315				74800	0			40 gpm, restart operation
	1330	15			75400	600	40		
	1600	17 1/2			93600	18200	202	0	Sample 48
	1700	18 1/2			106200	12600	210	0.150	210 gpm 50
	1910	20 1/2			129400	23200	194	0.160	52
	2200	23 1/2			165000	35600	198	0.063	54
6-21	0000	25 1/2			197000	32000	266	?	Questionable flow reading; sample 56
	0400	29 1/2	211300	14300	225600	28600	119	0.055	57-cut down flow because of high endrin/bubbles
	0800	33 1/2			252100	26500	111	0.050	Sample 58
	1030	36	248500	16800	265300	13200	88	0.084	62
	1300	38 1/2			282490	17200	115	0.100	65
	1600	41 1/2			303400	20900	116		
	2000	45 1/2			332000	28600	119		73
	2330	49	333000	22650	355650	23650	113		
6-22	0200	51 1/2			373040	17400	116		
	0500	54 1/2			393980	20900	116		

CARBON FILTER PLANT

Date	Time	Hours of Operation	Large Meter	Small Meter	Total	Gallons Since Last Reading	Flow Rate, GPM	Effluent Endrin, ppb	Remarks
6-22	0800	57 1/2			415430	21600	120		Sample 74
	0905	58 1/2			423000	7600	117		
	1100	60 1/2			437000	14000	122		Sample 78
	1330	63			454700	17700	118	0.65	Shut down because of high endrin concent.
6-23	2015	63			458160	-			Restart with electric motor @ 50,75 gpm
	2045	63 1/2						0.914	Reach full flow of 169 gpm; sample 106
	2200	64 1/2			474500	16300	155	0.925	Sample 111
6-24	0000	66 1/2			494070	19600	164*	0.102	
	0120	68			508900	14800	185*	0.055	
	0235	69			520920	12000	160*	0.105	
								0.140	@ front end of tank top
	0300	69 1/2			526110	5200	208*		
	0600	72 1/2			555400	29300	163*		
	0845	75 1/2			?			0.030	
	0900	75 1/2			585480	30100	167		
	1150	78 1/2	576390	38000	614400	28900	170		

* Av. = 168 gpm which is pump cpy.

CARBON FILTER PLANT (continued)

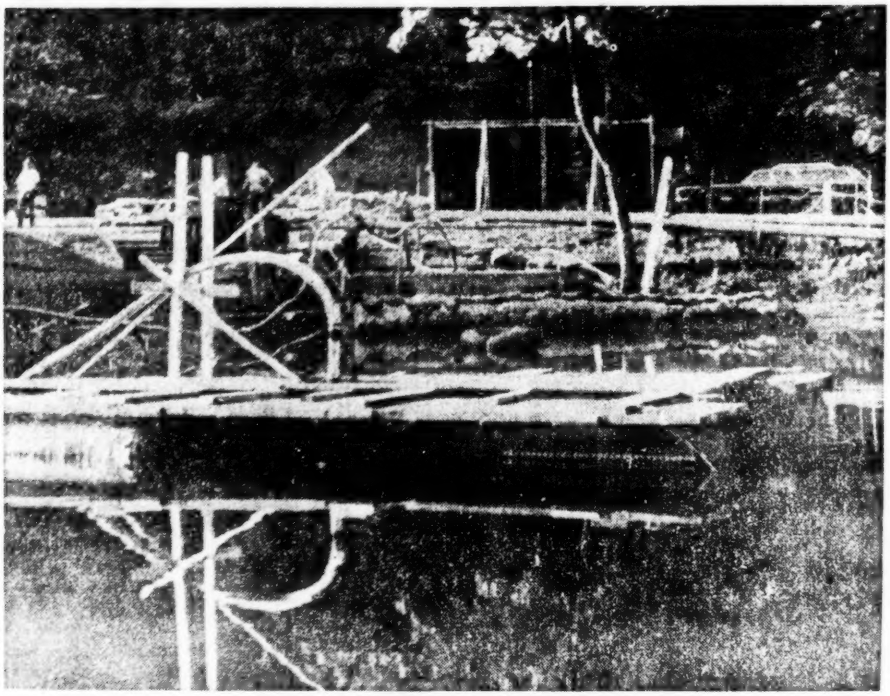
Date	Time	Hours of Operation	Large Meter	Small Meter	Total	Gallons Since Last Reading	Flow Rate, GPM	Effluent Endrin, ppb	Remarks
6-24	1300	79 1/2	586400	38800	625200	10800	155		Stop pump to remove section of fire hose
	1330	79 1/2			626300	-			Restart @ 185 gpm
	1440	80			631800	5500	183		
	1445	81			640100	8300	185		
		← 20 min. shut-down							
	2030	86 1/2			697900	57800	178	0.203	Reduced pump rate because of high endrin
	2245	89			719080	21200	157	0.350	
6-25	0030	90 1/2			736740	17700	169	0.283	
	0200	92	705800	45650	751450	14700	163		
	0500	95	735500	47350	782850	31400	174		
	0800	98	763800	48980	812780	29900	166	0.060	Increased flow rate to 180 gpm at 8 a.m.
	1015	100			836590	23800	177	0.093	

APPENDIX G

NEWS RELEASES

Included as follows is a chronological selection of news releases pertaining to the hazardous spill emergency at Pond Lick Lake. These articles appeared in newspapers within the State of Ohio and in newspapers throughout the country, including the New York Times.

PORTSMOUTH, OHIO, THURSDAY, JUNE 24, 1971



NEW PUMP. A new pump, capable of moving more of the poisoned water from Shawnee Lake through the filtered charcoal bin, is in operation today. The pump, assembled in Salem and flown here by the Ohio Department of Natural Resources, is shown (foreground) mounted on steel barrels. The pump itself, capable of pushing 169 gallons of water a minute through the filter (background) is beneath the surface of the lake. The new pump was installed by Ryckman, Edgerley, Tomlinson & Associates of St. Louis, under the direction of Tom Stewart of the Ohio Department of Natural Resources. Gary D. Hiles, 24, of 411 Sinton St., has been charged with putting poison in the lake. (Times photo by Billy Graham.)

Bypass Built At Poisoned Lake

PORTSMOUTH, Ohio (Special) — Ohio Department of Natural Resources workmen were constructing a dam and bypass Sunday to reroute fresh water around the pesticide-poisoned Pond Lick Reservoir in nearby Shawnee State Park.

Everett Ridge, wildlife supervisor for the District Four Department of Natural Resources, said at 5 p. m. Sunday that the dam was partially built, but would not be completed before sunset Sunday as Department of Natural Resources officials had hoped.

Ridge said that about 7200 pounds of activated carbon have been dumped into the lake in an attempt to absorb the pesticides, a mixture of Endrin and strychnine.

Robert Redett, chief of forestry and reclamation for the Department of Natural Resources said workmen were installing several large pumps to pump fresh incoming water around the reservoir. Redett said workmen also were installing 2400 feet of 20-inch pipe through which the incoming water will be pumped.

Redett said very little water was coming into the reservoir. He said most of the incoming water was seepage.

BUT JOHN BARRETT, assistant chief engineer for the Natural Resources Department, said state workers had begun building a huge filter in the spillway of the lake in case a heavy rain raises the water level.

Nelson Thomas, a biologist for the federal Environmental Protection Agency, said it is too early to determine if the carbon treatment will be a complete success in purifying the water, but said he was optimistic it would.

Gary D. Hiles, 24, of Portsmouth, is being held in the Scioto County jail on five charges in connection with poisoning the lake.

He is accused of dumping a gallon of corn soaked with strychnine and a half gallon of Endrin into the lake. No motive has been given.

The poison killed all acquatic wildlife in the lake, including about 3400 fish and a large number of frogs, crawfish and snakes.

From the CINCINNATI ENQUIRER, June 14, 1971

PORTSMOUTH, OHIO, TUESDAY, JUNE 8, 1971

Water Samples Studied As Fish Die In State Lake

More than 4,000 fish have died in Shawnee Lake during the last few days and state officials are trying to determine the cause.

Larry Rine, state game protector, said water samples are being sent to Columbus. He said several fish were seen floating on the surface of the water last Thursday. More and more fish surfaced and now officials fear all species in the lake may be dead.

Rine said a strong smell from the dead fish is keeping people away from the lake.

PORTSMOUTH, OHIO, THURSDAY, JUNE 10, 1971

City Man Is Charged In Poison Case

A 24-year-old Portsmouth man is in the Scioto County jail in lieu of bonds totaling $3,300 on charges of poisoning fish in Shawnee Lake.

The man, Gary D. Hiles, 24, of 411 Sinton St., pleaded innocent today in Municipal Court to killing fish in Shawnee Lake by posioning. Bond was set at $100.

He entered no plea to a charge of destruction of property and bond was set at $1,000.

He also entered no plea to a charge of putting poison in a reservoir and bond was set at $2,000.

He pleaded innocent to two charges of prohibition against placing deleterious substances in the waters of the state. No date has been set for hearing and bond was set at $100 on each count. He is to return to court June 17 on the other charges.

Hiles was arrested at 9:10 p.m. Wednesday by Sheriff John P. Knauff and Ohio Division of Wildlife officers after an intensive investigation into the poisoning of thousands of fish in the lake.

Between 3,000 and 5,000 fish have died in the lake during the last few days and state officials are attempting to determing the cause.

Hiles is accused of putting poison in the lake on June 2. Water samples are being checked by the State Department of Health.

Officials have asked the public not to use the lake until any possible danger can be determined. The lake is near the former Shawnee Honor Camp.

PORTSMOUTH, OHIO
THURSDAY, JUNE 17,
1971

Hiles Denies Guilt On Two Charges; Hearing Slated

Gary D. Hiles, 24, of 411 Sinton St., entered innocent pleas this morning in Municipal Court to two felony charges in connection with the poisoning of Shawnee Lake June 2.

He entered the pleas on charges of destruction of property by destroying about 3,400 fish and putting poison in a reservoir. Hiles remains in the county jail in lieu of $2,000 bond on the poison charge and $1,000 on the destruction of property charge. A preliminary hearing is set June 30.

Hiles entered innocent pleas last week to three misdemeanor charges and went to jail in lieu of $100 bond on each count. One charge was poisoning fish in the lake, and two other charges were placing deleterious substances in the waters of the state.

From the PORTSMOUTH TIMES, Friday, June 11, 1971

Teams Continue Sampling To Trace Poison Spread

By PAUL NELSON
Times Staff Writer

Federal Environmental Protection Agency officials from Cincinnati took samples from Shawnee Lake today in an effort to determine the concentration of poison that has killed thousands of fish in and near the lake.

Working in the lake area and downstream in portions of Turkey Creek were Loys Parrish, a biologist; Darrell DeRuiter, sanitary engineer, and Richard Johnston, aquatic sampler.

Parrish said the team had been instructed by their office in Cincinnati to determine what has poisoned the lake and how much of the poison was used. He said a high concentration of the suspected poison, Endrin, which is a pesticide, could affect the Ohio River if a flash flood or heavy rains drench the area.

"Our concern is the Ohio River and that's why we're here," Parrish said. He said Endrin will dilute in water but it could take a long time. He added that the problem could be more serious if a gallon of the substance actually was put in the lake.

Everett Ridge, district supervisor of Ohio Department of Natural Resources Division of Wildlife said he has contacted medical experts in Columbus and Cincinnati and they have estimated that a large concentration of Endrin could take as long as 10 years to disperse.

Without rain, the substance could remain in the lake for some time, Parrish said. A stench surrounds the area and little aquatic life is visible. Warning signs have been posted around the lake but no guards were noticed when Times newsmen visited the area this morning. Children were observed playing on the banks of Turkey Creek further downstream.

Sheriff John Knauff had deputies and special deputies knocking on doors of houses along Turkey Creek Thursday night warning them of the possible danger.

Parrish said the results of the analysis of the samples taken will be sent to state officials in Columbus.

The man charged with causing the poisoning of some 3,400 fish, Gary D. Hiles, 24, of 411 Sinton St., is being held in the Scioto County jail under bonds totaling $3,300, on five charges in connection with the poisoning of the lake.

Dale Roach, enforcement supervisor for the Ohio Department of Natural Resources wildlife division said, "There is no known method of diluting Endrin and there is no way to isolate it."

Officials are guessing that about a half-gallon of the pesticide and possibly as much or more strychnine was dumped into the lake. Hiles reportedly gave no reason.

Roach said Endrin is one of the more toxic of the chlorinated hydrocarbon pesticides and is used for mouse control in orchards during the winter. He said that Endrin "is the most toxic compound for aquatic life. Tests have shown that .003 parts per million in water will kill fish. By contrast, .01 parts per million are harmful to humans."

Merl DeVoe, state game protector, may have suffered a reaction from the poison when the retrieved a jug from the lake for tests, Roach said.

Very little water has moved over the dam so far into Turkey Creek. Dead fish have been sighted about a half-mile below the dam.

Roach said no one, including health officials and Shell Chemical Co., which makes Endrin has any idea how to counteract or dissipate it.

Roach said there was no truth to earlier reports that the drinking water in Shawnee State Park comes from the lake. He said he did not know if any of the people living downstream use the water for drinking.

Authorities have not given a motive for the lake poisoning.

They reportedly arrested Hiles after receiving a tip from someone who works with him at a Portsmouth pesticide firm.

The Endrin had been in the jug that was recovered, but Roach said he did not know how full it was when emptied into the lake. The strychnine was found in shelled corn, a common method for controlling sparrows.

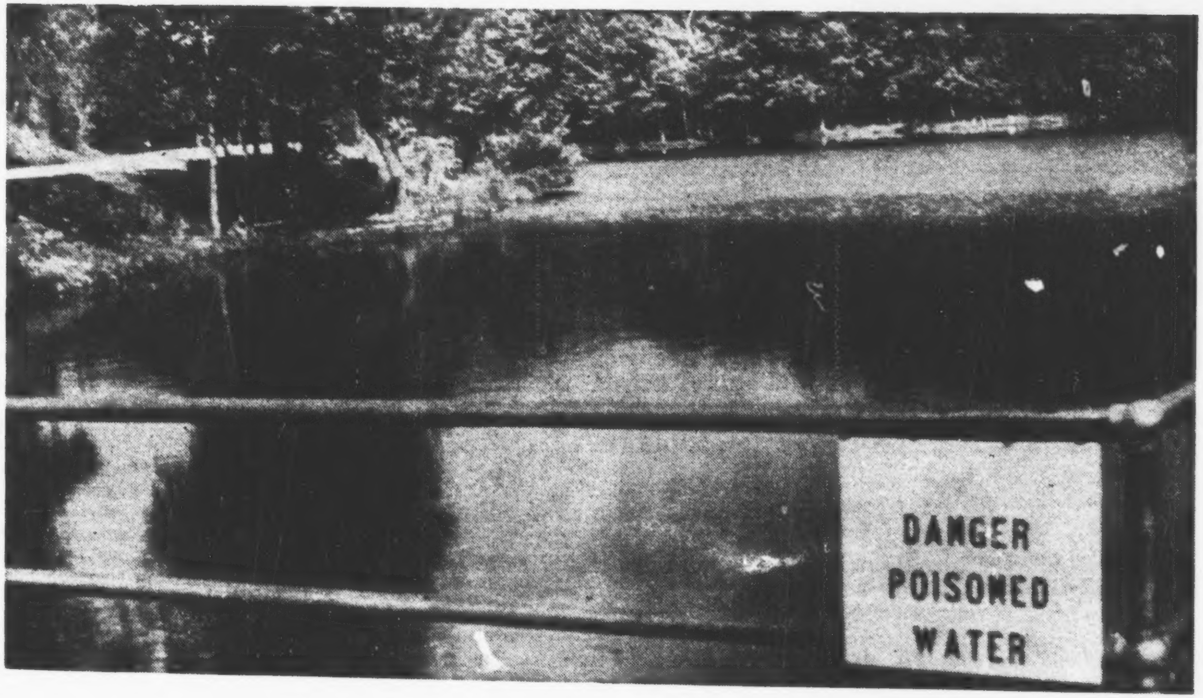
Officials Try Charcoal To Trap Poison Dumped In Shawnee Lake

Ditching Is Started To Divert Flow

Teams directed by state and federal officials continued work today to neutralize a deadly pesticide dumped into Shawnee Lake June 2, and prevent a spill into Turkey Creek, an Ohio River tributary.

Activated charcoal is being dumped into the Pond Lick reservoir to absorb the poison, Endrin, which has killed more than 2,500 fish and frogs, and a ditch is being dug to rechannel Pond Lick around the three-acre lake.

Gary D. Hiles, 24, of 411 Sinton St., who is charged with poisoning the reservoir, has pleaded innocent to three of the five charges filed in the case.



Portsmouth, Ohio, June 12, 1971, pg. 2

David Meeker, assistant director of the Ohio Departmen of Natural Resources, said federal charges may be brought against Hiles, who was formerly employed by a firm that uses pesticides.

Everett Ridge, district supervisor of the wildlife division of the state department of natural resources, said work would continue through the weekend to contain the polluted water and deactivate the poison.

This morning's rain wasn't expected to create any problem since the water level was about four inches below the top of the spillway which has been sandbagged for additional protection.

Water samples are being checked regularly to determine the effectiveness of charcoal purification. The poison's strength was estimated Friday to be 13 times the federal guideline maximum for safe drinking water.

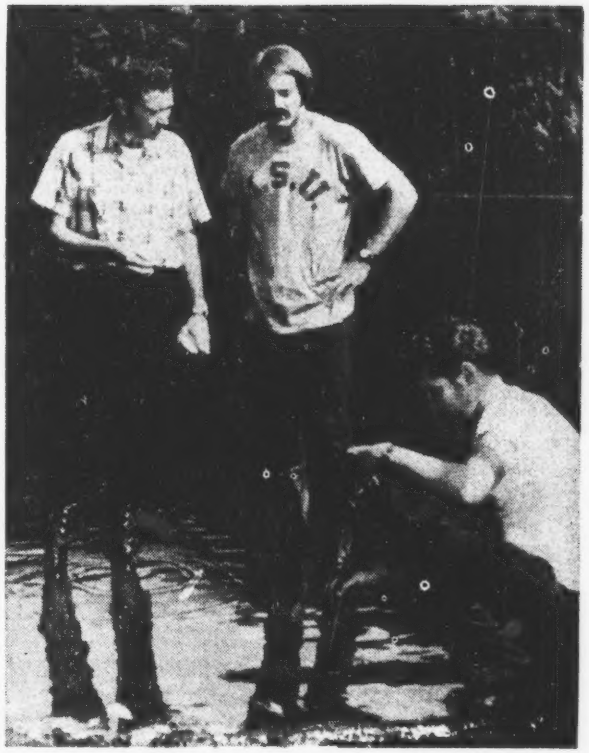
The lake holds an estimated 15,000 gallons of water and this may have to be pumped out and filtered and the poison-laden charcoal and mud dredged from the bottom of the reservoir.

During their investigation, officials recovered a jug which they said had contained Endrin, and strychnine impregnated corn, which is often used for killing sparrows.

Dead crawfish have been found along the creek a half-mile below the reservoir and area residents have been warned not to use water from the stream.

Meeker said in Columbus rechanneling should take only one day and would clear the way for pumping the lake dry and dredging the charcoal and the absorbed pesticide from the bottom.

Loys Parrish, a federal Enviromental Protection Agency biologist, said a high concentration of Endrin would take up to 10 years to disperse.



POISONED LAKE. Thousands of fish have been killed as the result of the poisoning of waters of Shawnee Lake (top). Officials believe the three-acre lake was contaminated by a strong pesticide known as Endrin and also with strychnine. Representatives of the Federal Environment Protection Agency office at Cincinnati (bottom) check samples of water and aquatic life which may cause poisoning of the Ohio River. Left to right are Loys Parrish, biologist; Darrell DeRuiter, sanitary engineer, and Richard Johnston, aquatic sampler. (Times photos by Billy Graham.)

PORTSMOUTH, OHIO, MONDAY, JUNE 14, 1971

SAFE WATER FIGHT. Hundreds of pounds of activated charcoal were dumped in Shawnee Lake Sunday in an effort to neutralize a deadly pesticide which has killed all fish and frogs in the lake. Workmen also placed bags filled with charcoal at the dam's spillway (bottom) so water escaping from the lake would be filtered through charcoal. Officials are building a pipeline around the lake in an effort to drain away surface water which ordinarily would go into the lake. Officials say the poison level in the lake is dropping, but is still dangerous. (Times photo by Billy Graham.)

State Continues To Fight Poison In Shawnee Recreational Lake

By **ROBERT BASS**
Times Staff Writer

Simulated laboratory tests in Memphis, Tenn., may develop a method to clear the poison from Shawnee Lake.

Samples of the poisoned water have been sent to Memphis for the tests to be conducted by consultants of the U.S. Environmental Protection Agency.

William B. Nye, Ohio Natural Resources director, said Tuesday any decision on methods of clearing the lake of the poison will have to await results of the tests.

He said the 7,200 pound of carbon spread over the three-acre lake in Shawnee State Forest has failed to reduce the lake's poison level substantially.

The state had hoped the activated carbon would dilute the poison spilled into the lake June 2. The gallon of Endrin, a pesticide, and strychnine, the poison, killed the lake's aquatic life.

The measured poison level of from eight to nine parts per billion in the lake Sunday had decreased to from six to seven parts by Tuesday, Nye said.

The amount remains highly poisonous, he said.

The state's natural resources director said it is felt that steps already taken to isloate the poisoned water and preventing its spread are sufficient.

Nye said the following three alternatives for clearing Shawnee Lake are under study:

Using a system of controlled carbon filtration, similar to ter to water suitable for drinking. Under this proposal, the lake water would be pumped through carbon, rather than spreading the carbon on water, as was done last weekend.

Converting the lake into a biological lagoon of the type used for sewage treatment.

Using clay or some other compound to absorb the poison.

Nye returned to Shawnee Lake Tuesday for renewed consultation with state and federal personnel attempting to find a solution to the problem of the lake poisoning.

Poisoning of the lake is reported to have resulted in an official count of 3,400 dead fish. This probably is about half the total kill, Larry G. Rine, Scioto County game protector, said.

For safety's sake, the lake has been isolated.

The spillway from Shawnee Lake to Pond Lick and Turkey Creek is sandbagged and sealed. To prevent seepage, additional sandbags and plastic sheets have been placed there. A bed of carbon to filter any water seepage has been set up.

Beyond the dam, a catch basin has been created, and any water getting through is being returned by pump to the lake.

A cofferdam has been established at the rear of the lake, and any rainwater running off is being diverted around the lake.

Officials had feared the poisoned water might flow into the Ohio River and cause problems with water systems downstream.

The lake, located about 10 miles west of Portsmouth, had been a popular recreation area for picnickers, fisherman and sunbathers.

Accused on five counts in connection with the poisoning, Gary D. Hiles remains in Scioto County Jail in lieu of $3,300 bond. He is scheduled to appear in Municipal Court Thursday morning.

PORTSMOUTH, OHIO, WEDNESDAY, JUNE 16, 1971

The Cincinnati Enquier, June 11, 1971

Poison Threatens Ohio River Water

By BOB ROTHE
Enquirer Environment Reporter

PORTSMOUTH — The dumping of poison into Shawnee Lake in a state park near here has killed all of the aquatic life in the lake and poses a continuing threat to Ohio River water.

THE POISON dumped into the three-acre lake was a combination of Endrin, a powerful pesticide, and strychnine, Scioto County Sheriff John Knauff said. He estimated that about a half gallon of each entered the lake.

"There is no known method of diluting the compound and there is no way to isolate it," said Dale Roach, enforcement supervisor for the Ohio Department of Natural Resources' wildlife division.

There is also some concern on the part of the federal Environmental Protection Agency officials that the poison could be carried from the lake along the Turkey Creek tributary to the Ohio River, thereby possibly threatening water supplies of those communities which get their water supply from the Ohio.

The poisoning apparently occurred June 2, Knauff said.

Garry D. Hiles, 24, Portsmouth, has been named in five charges in connection with the incident, Knauff said.

Endrin is one of the more toxic of the chlorinated hydrocarbon pesticides and is used for mouse control in orchards during the winter.

ROACH EXPLAINED that Endrin is the most toxic known compound for aquatic life. (Tests have shown that .003 parts of Endrin to a million parts of water will kill fish; by contrast .01 parts per million is harmful to humans.)

Efforts are being made to prevent persons from having direct contact with the poisoned lake, Roach said.

One of the wildlife division's game protectors, Merl DeVoe, may have suffered a reaction from the poison when he recovered a jug from the lake, Roach said.

He also noted concern that some persons may be using the 12-mile stretch of Turkey Creek below the lake for water supply.

It is hoped that if the compound gets into the Ohio River the dilution from the large volume of water will decrease the poison below harmful levels.

For the present the poisoned water is contained in the man-made lake with the exception of small amounts that the wind has lifted over the dam. In these instances there have been fish killed as far as a half mile below the dam.

The total fish kill has been estimated at 3400.

Hiles, who is being held in the county jail in lieu of $3300, faces charges of destruction of property, administering of poison and three counts of killing fish. Entry of a plea will be heard next Thursday in municipal court in Portsmouth.

THE NEW YORK TIMES, SUNDAY, JUNE 27, 1971

Pesticide Poisons Lake in Ohio

By **GEORGE VECSEY**
Special to The New York Times

PORTSMOUTH, Ohio, June 22 — Until three weeks ago, Shawnee Lake was just another quiet fishing hole in the southern Ohio hill country. Then somebody with half a gallon of pesticide turned it into five acres of death.

Within two days, all 3,400 sunfish and carp and bluegill in the man-made lake floated dead on the surface, along with numerous frogs and snakes.

Since then, officials from Federal, state, local, college and private sectors have worked around the clock to prevent damage to humans, to the water downstream and to the total environment of Shawnee State Park.

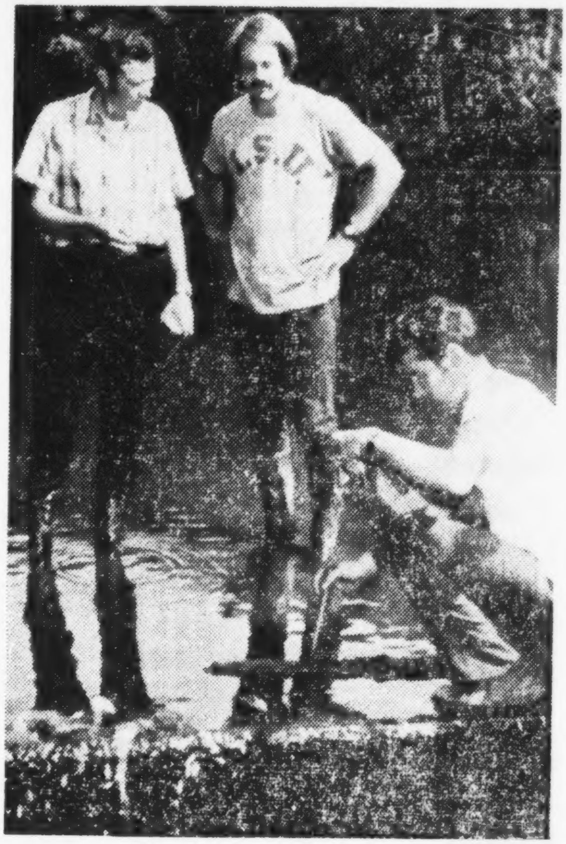
They say they will save the lake by August, but at a cost of at least $30,000, not to mention man-hours lost from other jobs.

A suspect, 24-year-old Gary D. Hiles of Portsmouth, has been arrested and held in $3,000 bail on charges of destroying state property and wildlife. Officials say there are witnesses who saw Mr. Hiles throw a jug into the lake and there is a report that Mr. Hiles was upset after being dismissed by a company that distributes the pesticide, Endrin. Mr. Hiles has pleaded not guilty to the charges.

A "Restricted" Chemical

Endrin is similar to DDT, according to William Nye, director of the Ohio Department of Natural Resources. The chemical is "restricted" by the state for limited use as a rodent killer but it is sold to any private citizen. Mr. Nye said that Endrin was dangerous at one part per billion and lethal at that dosage "in prolonged usage."

The manufacturer says that Endrin breaks down in three months, but Mr. Nye insists that the process often takes two years.



Associated Press

Officers of the Environmental Protecting Agency check for signs of aquatic life in the waters, poisoned by a chemical, of Pond Lick Reservoir, near Portsmouth, Ohio.

New York Times, June 27, 1971, p. 2

"If a drug is dangerous for human consumption, you need a prescription for it," Mr. Nye said. "But if a chemical is not for human consumption, it's available without a prescription. Yet it can go into the food chain by clinging to a plant for two years and being eaten by cattle and passed on to infants in milk."

Because Endrin is not broken down by water, the officials felt obliged to remove it from Shawnee Lake before it floated through seven miles of creeks and into the Ohio River. But there was no simple, established procedure for the job.

While Mr. Nye summoned his staff from all over Ohio, a young graduate micro-biologist from Ohio State University, David Howard, brought down a chromatograph, which tests water samples but had never been transported outside the laboratory in Columbus. The chromatograph soon indicated that the toxic level was eight parts per billion throughout the lake.

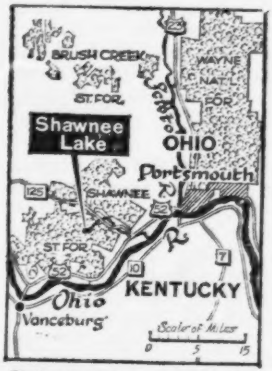
Stream and Spillway Shut

Meanwhile, the feeding stream above the lake and the spillway below were closed off, and a cleaning system was devised by Mr. Nye, Dr. Hugh Thompson of the Environmental Protection Agency in Washington and Dr. S. James Ryckman of a St. Louis and Dayton water consulting firm.

The men set up a model system, pumping water from the lake into a small tank, then running the water through a carbon chemical, "filtrasorb," which had been rushed, at cost, by the Calgon Company from its plant at Catlettsburg, Ky. Filtrasorb drew the pesticide from the water—"adsorbed" is the technical word—and passed the purified water out the other side.

Dr. Ryckman demonstrated the purity of the water. He drank some of it.

Then Dr. Thompson called for a cypress-board tank with a capacity of 24,000 pounds from the Environmental Agency's Cincinnati office. Pumps and hoses were assembled from various sources, including the local fire department. Calgon delivered 600 sixty-pound bags of Filtrasorb. The pumps pushed water upward at 500 pounds per minute throughout the chemical in the cypress tank. And clean water began to flow downstream again.



The New York Times June 27, 1971

The scientists say it will take them 21 days to lower the lake by 10 feet. If the water is clean at that level, they will cleanse the sides of the lake and refil it. They feel they will be finished by August, when the lake will be restocked with fish from state hatcheries.

"I think this is a classic example of forgetting the bureaucracy and just getting the job done," Dr. Thompson said. "Everybody cooperated — particularly the local workmen who have worked late every night. We're just sorry it happened in the first place."

PORTSMOUTH, OHIO, THURSDAY, JUNE 17, 1971

Team Confident That Filters Will Clear Lake

By ROBERT BASS
Times Staff Writer

An active carbon filtration plant may extract the poison from Shawnee Lake waters.

Representatives of a water resource consultants firm expressed confidence the procedure, being initiated for a trial period, will work.

That trial period was begun Wednesday afternoon with a pilot plant set up and placed in operation at the lake by Ryckman-Edgerley-Tomlinson and Associates of St. Louis.

This firm of consultants in water, solids and air resources has been engaged for the Shawnee Lake project under contract with the U.S. Environmental Protection Agency.

The pilot plant is to be in operation for a trial period of 24 hours a day for several days. If it suceeds, a larger, prototype plant will be set up at the lake.

Dr. Cecil Lue-Hing, a vice president of the St. Louis firm, said the prototype plant would be the equivalent of a small water treatment plant of the type the Army might set up at an advanced base.

It would be the equivalent, too, of a water treatment plant a small city of perhaps 10,000 persons would use, he added.

"We do feel confident the poison can be removed by activated carbon filtration and absorption," another spokesman for the St. Louis firm said.

The pilot activated carbon absorption plant was set up at the lake and placed in operation by Dr. Lue-Hing; Joseph Dieterman, senior associate, and William (Bill) Anderson, senior environmental engineer, with the St. Louis firm.

The portable pilot plant uses a pressure pump and hoses, a swimming pool filter, and a tall metal activated carbon column.

Water pumpd from the lake is filtered and absorbed in activated carbon. Surfaces of the activated carbon particles will pick up the poison from the water. Hopefully, clean, filtered water then can be returned to the lake.

"We'll keep this portable plant in operation for two, possibly three, days, depending upon what we find out," Dr. Lue-Hing said.

Marvin Katz, Ohio Department of Natural Resources chief of public information, said the pilot carbon filteration plant project will determine which is the more effective method of removing poison from the lake—the controlled carbin filtration procedure, or the method of spreading carbon on the water, as was done last weekend.

He added that tests of Shawnee Lake water samples being conducted in the federal Environmental Protection Agency laboratories in Memphis, Tenn., will have an influenceing effect on any ultimate decision in coping with the problem of the poisoned water.

"But, we do want to take a close look at all possible variables — even the variables on the alternatives."

Alternatives under consideration are the possiblilities of converting the lake into a biological lagoon of the type used for sewage treatment; or [illegible] other type of compound to absorb the poison.

Katz said that if the pilot plant project is successful, the possibility of setting up the larger prototype plant downstream in the area of the causeway, will be considered.

Robrt Redett, assistant chief of the Ohio Department of Resources of Forestry, said the prototype plant would be larger, modified version of the pilot plant.

Katz said no decision yet has been made on funding of the total project, nor is it yet known how much the total project ultimately will cost.

The bulk of the costs involved so far has been taken care of by state funds.

Work at Shawnee Lake is a cooperative project of the Ohio Department of Natural Resources and the U.S. Envirnmental Protection Agency.

Dr. Hugh Thompson of the federal Environmental Protection Agency, is the project officer, and all work at Shawnee Lake is being coordinated under his supervision.

The complex problem of extracting the Endrin, a pesticide, and strychnine, the poison, from Shawnee Lake is the first project in which the federal Environmental Protection Agency's Division of Hazardous Spill Protection ever has been involved. This division was founded only nine months ago.

Redett said Wednesday there's a possibility a gas chromatigraph can be brought to the Shawnee Lake project for quick, on-the-scene analysis of lake water samples.

He said the apparatus would make it unnecessary to send further samples to Taft Laboratories in Cincinnati, or to the laboratories in Memphis.

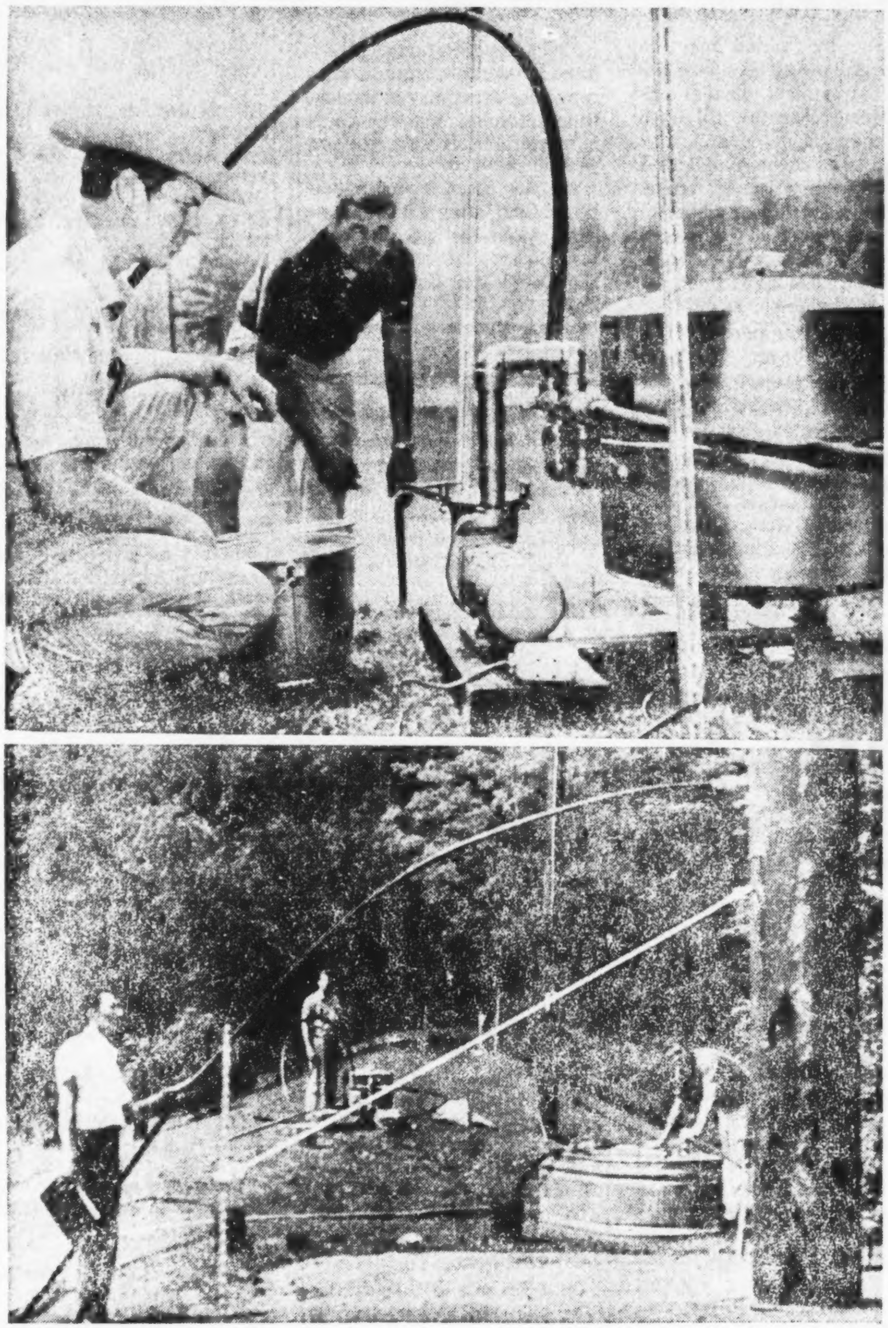
Dieterman added that the gas chromatigraph could analyze water samples in about an hour. Effectiveness of the pilot activated carbon filtration and absorption plant project could be determined at the scene, he said.

The lake and its poisoned water are isolated and contained; the problem of removing, or extracting, the poison is yet to be solved, Redett said.

Shawnee Lake has been a popular recreation area for fishermen, picnickers and sunbathers. Even before the poisoning, swimming at the lake had been prohibited.

Aquatic life in the lake has been killed by the poison. "It, therefore, must be considered highly toxic," Redett said.

Portsmouth, Ohio, June 17, 1971, pg. 2



PILOT PLANT. A portable pilot plant for activated carbon filtration and absorption was set up and placed in operation at poisoned Shawnee Lake Wednesday afternoon by representatives of Ryskman-Edgerley-Tomlinson and Associateof St. Louis, Mo., employed under contract for the poison removal project by the U.S. Environmental Protection Agency. In top photo, William (Bill) Anderson, (left), senior environmental engineer, and Joseph Dieterman, senior associate, with the St. Louis firm, activate the portable plant's pressure pump. In bottom photo, Dr. Cecil Lue-Hing, (extreme left), a vice president of the firm, Dieterman and Anderson make final adjustments before starting the plant on its approximate three-day trial period. If the trial plant succeeds, a larger prototype will be set up at Shawnee Lake. (Times photos by Billy Graham.) (Another photo on Page 16.)

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however, the period may be longer, depending upon how often the treatment plant's tons of filtering charcoal will have to be changed.

Total costs of the complicated and involved project of removing the poison from Shawnee Lake are expected to exceed $100,000, William B. Nye, director of the Ohio Department of Natural Resources, said.

It has been estimated that approximately $50,000 has been spent on the project since the poison, spilled into the lake June 2, was discovered June 4.

Katz said it isn't yet known how cost will be apportioned in this joint project of the Ohio Department of Natural Resources and the U.S. Environmental Protection Agency.

The new treatment plant is capable of filtering 230,000 gallons of water a day from the 15-million-gallon Shawnee Lake.

Dr. Thompson, the project officer at the site, said, however, it will handle water flow at approximately the same rate as that handled by the successful pilot plant.

Built of hastily-assembled available materials, the prototype plant is to be operated on the "fail safe design concept," Dr. Thompson said.

The water is to be filtered from the upstream side of the dam, so that any leakage or drainage will go back into Shawnee Lake — or Pond Lick Reservoir, he said.

Water is being pumped from the lake and into the filtering tons of activated charcoal particles in the big cypress board box, then released into the spillway on the other side of the dam.

From there, it's to flow down Pond Lick and into Turkey Creek, and, eventually, into the Ohio River.

"It's a shame, really, that the clean, filtered water is going into the spillway. Once it's filtered in the treatment plant, it's cleaner than most drinking water," Dr. Thompson said.

The project officer said the prototype plant would more than meet the water treatment needs of a community of 10,000 persons.

The water filtration system is to be in operation until the concentration remaining in the lake is infinitesimal, and the water is unquestionably safe, the project officer said.

Samples taken from the lake before and after filtration are analyzed in the gas chromatograph operated in a former Shawnee Honor Camp building by a young Ohio State University graduate student — David Howard of Dayton.

Howard, working on his doctorate in OSU's Department of Microbiology, said the precision chromatograph can analyze a water sample in 45 minutes.

"Once a sequence of samples is started in the chromatograph any sample in the sequence can be analyzed in 15 minutes," he said.

The OSU graduate student said the little pilot water treatment plant set up on the dam at Shawnee Lake by the St. Louis firm of Ryckman-Edgerly Tomlinson and Associates "did indeed do the job."

He said the water that came out of the filter system in the old submarine ballast tank was pure — "cleaner perhaps than most of the water we drink."

In the first 11 hours after the little experimental water treatment plant was placed in operation, it filtered 14,000 gallons of water. A total of 17,000 gallons of water had been filtered through the pilot plant by 2 p.m. Friday.

Thirty-nine samples had been analyzed in the chromatograph by 2 p.m. Friday. Results of the tests left little doubt the experimental plant was filtering the Endrin, strychnine and other sediment from the water with great efficiency.

Once this was established, the little pilot plant was taken off its 24-hour schedule, and work started immediately on construction of the larger prototype plant.

Technicians of the St. Louis firm had set up the pilot plant under construction with aofrd under contract with the federal Environmental Protection Agency.

Dr. Thompson flew to Cincinnati to get the big box for the prototype plant. It had ben part of a large-scale water treatment plant operating at the Taft Center laboratories in Cincinnati

Under Dr. Thompson's supervision, employes of the Ohio Division of Forestry in Shawnee Forest helped construct the prototype in the garage near the Division of Forestry's headquarters.

The box was moved to the site of the lake's dam by flatbed truck and lowered into place by massive hooks.

The prototype system, enhanced by the ready availability of the chromatograph, not only is to work with water samples. It also is to test sediment taken at intervals from the lake bottom.

There was no need for a plan to drain the lake if there is no toxic content in the sediment, Howard said.

The OSU graduate student is to remain here until the poison removal project at the lake is complete. Dr. Thompson plans to return to Washington, D.C. in a "day or so," he said.

Katz and motion picture and still camera crews from the Ohio Department of Natural Resources were at the lake site Friday. Among others at the site was S. James Ryckman, vice president of the Ryckman-Edgerley Tomlinson firm of water and air resources consultants.

Assistant ranger at Pond Lick Reservoir, Frank Tackett, said that since the development of the new Turkey Creek Lake and the improvement program at Roosevelt Lake, "We've been attempting to encourage the public to use those facilities."

He said there's no lifeguard at Pond Reservoir, or Shawnee Lake, and swimming isn't permitted there.

"It is a shame, though, because some retired, older people had been coming out to Shawnee Lake on weekends and would spend a whole day fishing, Tackett said.

Poison removal work at the lake has increased the number of visitors to Pond Lick Reservoir, and Tackett says he thinks the next few weekends could bring between 300 and 400 people out here to look around."

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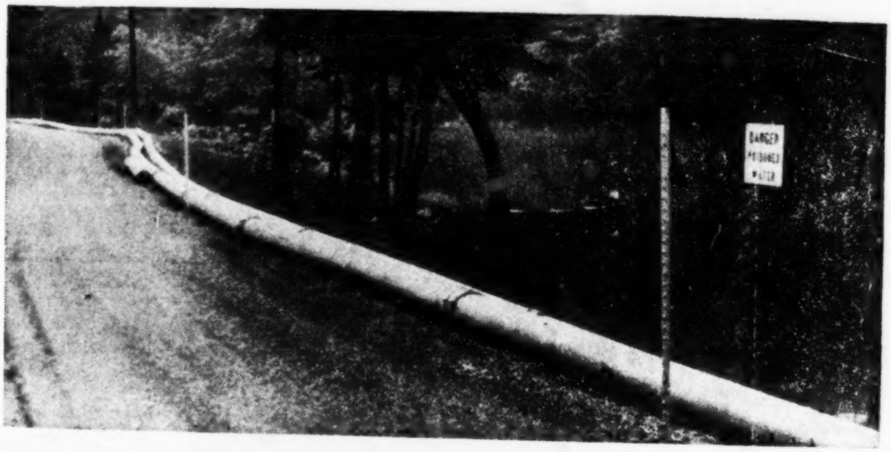

PIPELINE. Part of the cofferdam system set up at poisoned Shawnee Lake is this pipeline, which Robert Redett, assistant chief of the Forestry Division of the Ohio Department of Natural Resources, says has done a highly-effective job of diverting recent rain run-off around the lake. The pipeline has kept rainwater run-off from causing an overflow of poisoned water from the lake.

Outlook Is 'Good' For Clear Lake

By ROBERT BASS
Times Staff Writer

Shawnee Lake should be cleared of its poison by early August.

"Guesstimates" that the complex poison removal project should be completed within 45 days were made by conservationists who set up a larger, prototype water filtration plant at the lake late Friday.

Its operation begun this morning, this prototype plant replaces the smaller pilot, or experimental plant set up at the lake last Wednesday.

Decision to build and to use the larger, but more compact prototype plant came after it was discovered that the little experimental plant was working with watch-charm efficiency.

The portable pilot plant, with its precision pressure pump and hoses, its swimming pool filter, and its old submarine ballast tank filled with activated charcoal, has been disassembled.

Now operating in its place is the prototype plant with huge, rectangular box; 15,000 pounds of activated carbon, and pressure pump capable of pumping 500 gallons of water a minute.

Samples of Shawnee Lake water, before and after they're filtered through the big box of activated charcoal particles, are to be analyzed in a gas chromatograph brought to Shawnee Lake late Thursday from Ohio State University's Department of Microbiology.

This sophisticated instrument is to give almost instant analysis to Shawnee Lake water samples, making it unnecessary to send those samples either to the U.S. Environmental Protection Agency laboratories in Memphis, Tenn., or to Taft Central laboratories in Cincinnati.

The new water treatment plant, with its system of water filtration and absorption by activated carbon particles, is to be in operation until water remaining in the lake tests out absolutely safe, Dr. Hugh C. Thompson of the federal Environmental Protection Agency, said.

The consensus is that this should occur within 45 days.

Marvin Katz, Ohio Department of Natural Resources chief of public information, said,

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PROTOTYPE. Success of the little pilot, or experimental water treatment plant at poisoned Shawnee Lake resulted Friday in quick development of the larger, more compact prototype plant, which is to use about 250 bags of activated charcoal granules in its filtration system inside the huge box. In top photo, S. James Ryckman, vice president of the St. Louis firm of water and air resources consultants that developed and set up the successful pilot plant; and Dr. Hugh C. Thompson of the federal Environmental and Protection Agency, the poison removal project officer, finalize plans for setting up the prototype plant, upon which employes of the Ohio Division of Forestry (background) are working. In center and bottom photos, David Howard, graduate student in the Ohio State University Department of Microbiology, uses the precision gas chromatograph, brought in from OSU Thursday night, in analysis of water samples taken from the poisoned lake. The recorded peaks in the graph in center photo are the Endrin content in unfiltered water samples; the long, firm straight lines are the pure analysis of the filtered samples. In bottom photo, Howard uses a hyperdemic syringe to inject a water sample into the machine.

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A First We Didn't Need

Some of our records are such that we may be proud of them in a constructive sort of way. Some records are such that we'd rather not think of them, and others are such that we can be proud, despite the fact that perhaps we'd rather the need never had come up.

Of course we would have preferred that the poisoning of Shawne Lake never had occurred. We would have preferred to have left it alone, filled with fish and circled by fishermen.

Unfortunately, this didn't happen. The lake was poisoned and thousands of fish were killed. Many fishermen were deprived of their pleasures, and many other people were worried because of the potential threat if the poison had escaped the lake's confines.

We can be proud of none of these.

We can take great pride in the response of the many agencies concerned with clearing the lake of the poison. We can take pride in the fact that the discovery came early enough to prevent harm to persons who use the lake. We can take pride in the efforts of every individual concerned with the action in any way.

Since we had the problem, we also can take pride in the fact that this is the place where the recently created United States Environmental Protection Agency got its first real test.

The agency, not yet a year old, was called into the case early, and this action perhaps is to be credited for quick decisions on steps to take in fighting poisons.

It has been more than two weeks since first signs of the poison were reported, but the researchers have had complete cooperation from everything, including the weather, in striving to overcome the problem.

Now it appears that success is only a matter of time. Experiments have proved that the poison can be eliminated by mechanical-chemical processes, and the potential danger to the lake and to the waters which get the lake overflow will not be endangered.

Early estimates were that a natural clearing of the lake would take up to 10 years were no less than frightening, especially in consideration of the current growth and development in Shawnee State Forest. Now, with estimates that the lake will be cleared within as little as 45 days, it appears that we can stamp "success" on the project.

Expense has been no problem. Every agency concerned has gone all the way, setting no limit on efforts to clear poison. Such cases are rare, but this has been an unusual case from the beginning.

If there is any pride to be had in such a case, we are proud that the first real test of the U.S. Environmental Protection Agency, with its allied agencies, found its first success here.

We hate to think of what could have happened had this case been a failure.